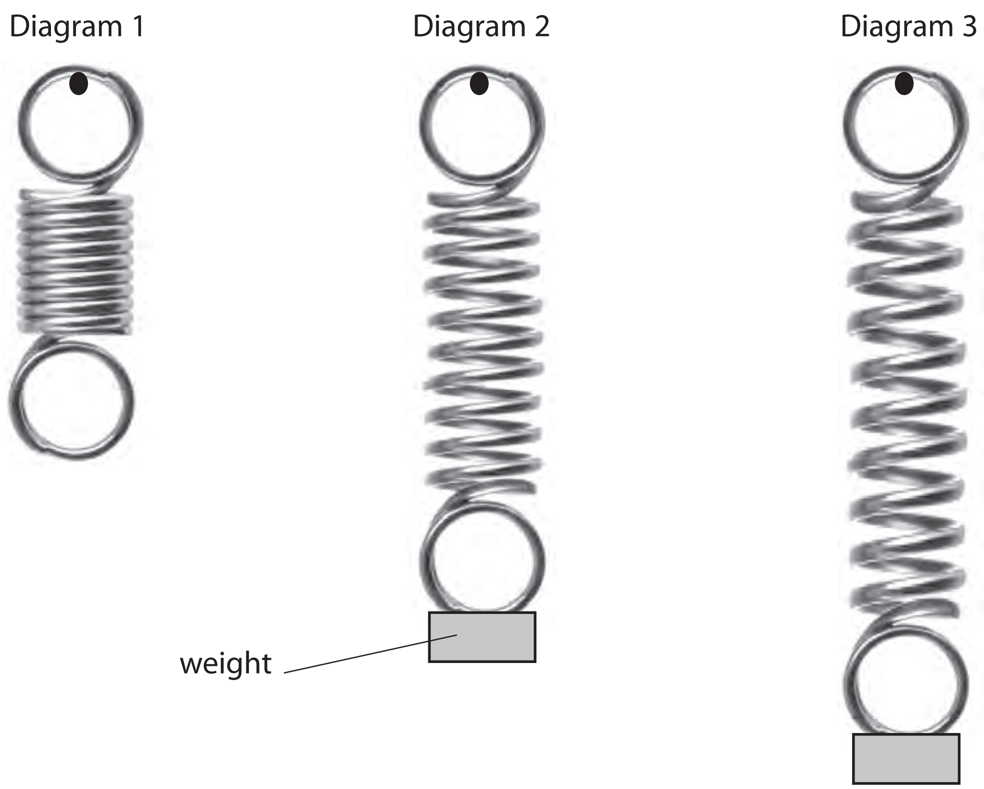
Springs and shock absorbers

1 (a) The diagrams show a spring hanging from a nail.

- In Diagram 1 there is no weight on the spring.
- Diagram 2 shows the spring after a weight is added.
- Diagram 3 shows the spring after the weight has been pulled down slightly.



(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

When held stationary as in Diagram 3,

(1)

☐ **A** the spring has zero elastic potential energy

☐ **B** the weight has equal amounts of elastic potential and kinetic energy

☐ **C** the weight has more kinetic energy than gravitational potential energy

☐ **D** the spring has more elastic potential energy than the weight has kinetic energy

(ii) The spring is stretched from the position shown in Diagram 2 to the position shown in Diagram 3.
The spring is then released.
Describe the energy changes that take place until the spring stops vibrating.

(3)

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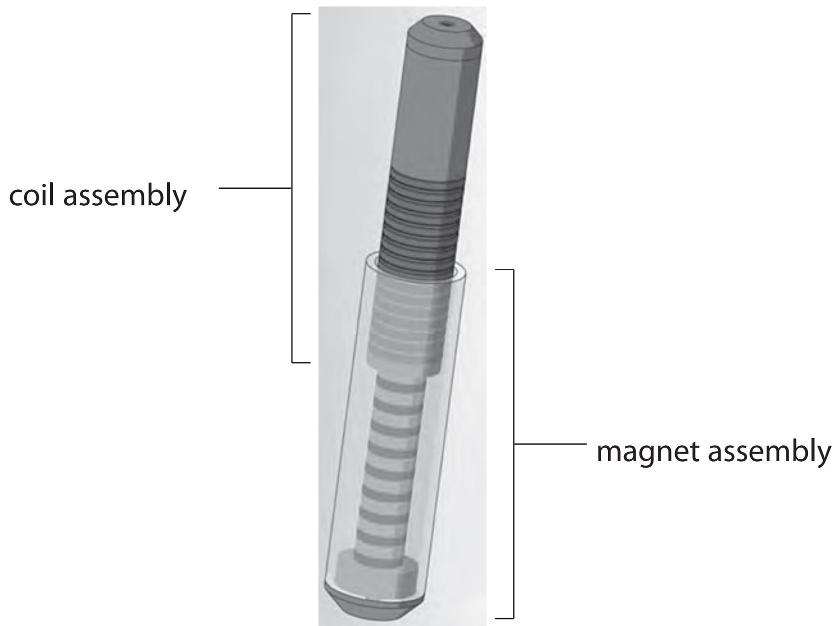
(b) Shock absorbers with springs are used on some motorcycles.
These shock absorbers reduce the bounce on an uneven road.
A new shock absorber has been developed to convert some of the movement energy into another form.
It consists of magnets which slide inside a coil when the motorcycle goes over a bump.



Some of the energy which would otherwise be wasted can be recovered and so fuel is saved.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

This device is designed to

(1)

☒ **A** increase the thermal energy obtained from the fuel

☒ **B** increase the efficiency of the motorcycle

☒ **C** decrease the speed of the motorcycle

☒ **D** decrease the braking power of the motorcycle

(ii) Explain how this new type of shock absorber can provide electrical energy.

(2)

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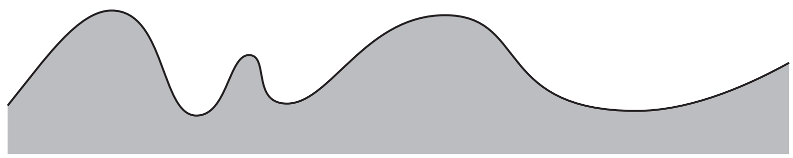
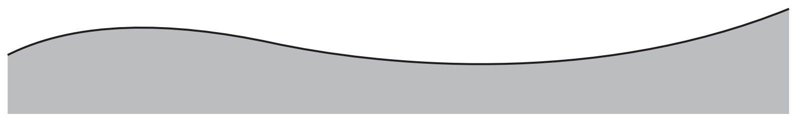
(iii) The diagram shows the bumps on the surface of two roads, L and M.
Explain why the device will transfer more energy on road L than on road M for a motorcycle travelling at the same speed.

(3)



road L



road M

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(Total for Question 3 = 10 marks)

2 A student uses a digital calliper to measure the length of a spring, as shown in Figure 20.

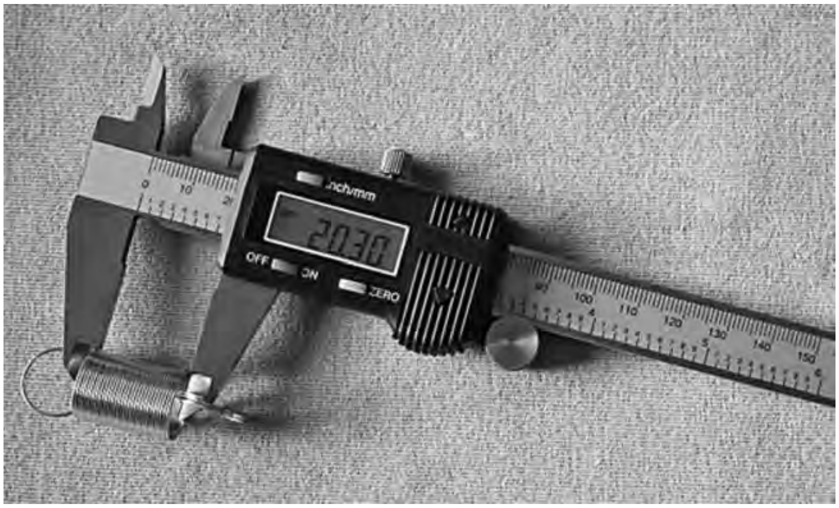


Figure 20

The spring is bendy and difficult to measure.

The student takes the six readings shown in Figure 21.

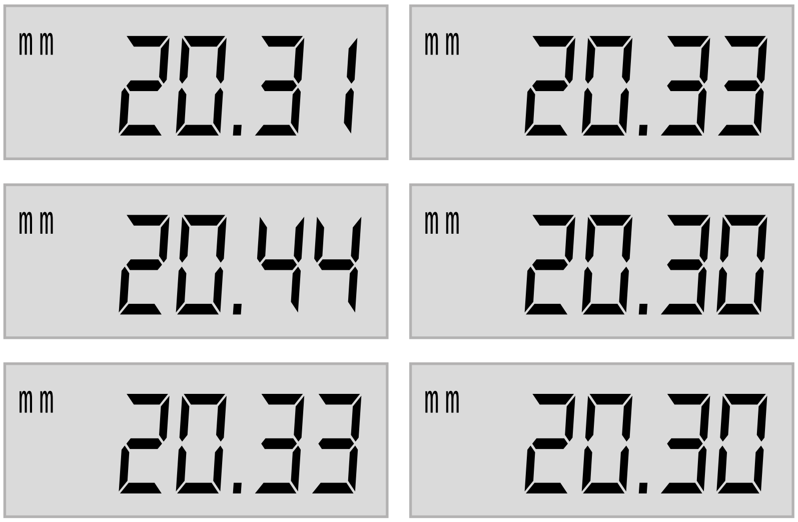


Figure 21

(a) Calculate the average length of the spring.

(2)

average length = ... mm

(b) The student investigates the stretching of a spring with the equipment shown in Figure 22.

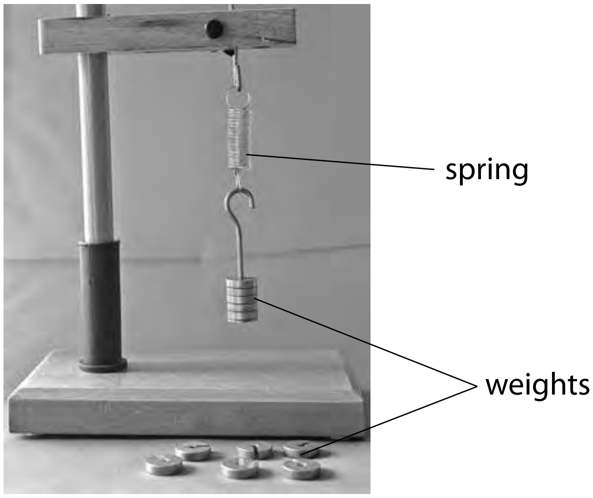


Figure 22

The student investigates the extension of the spring using six different weights.

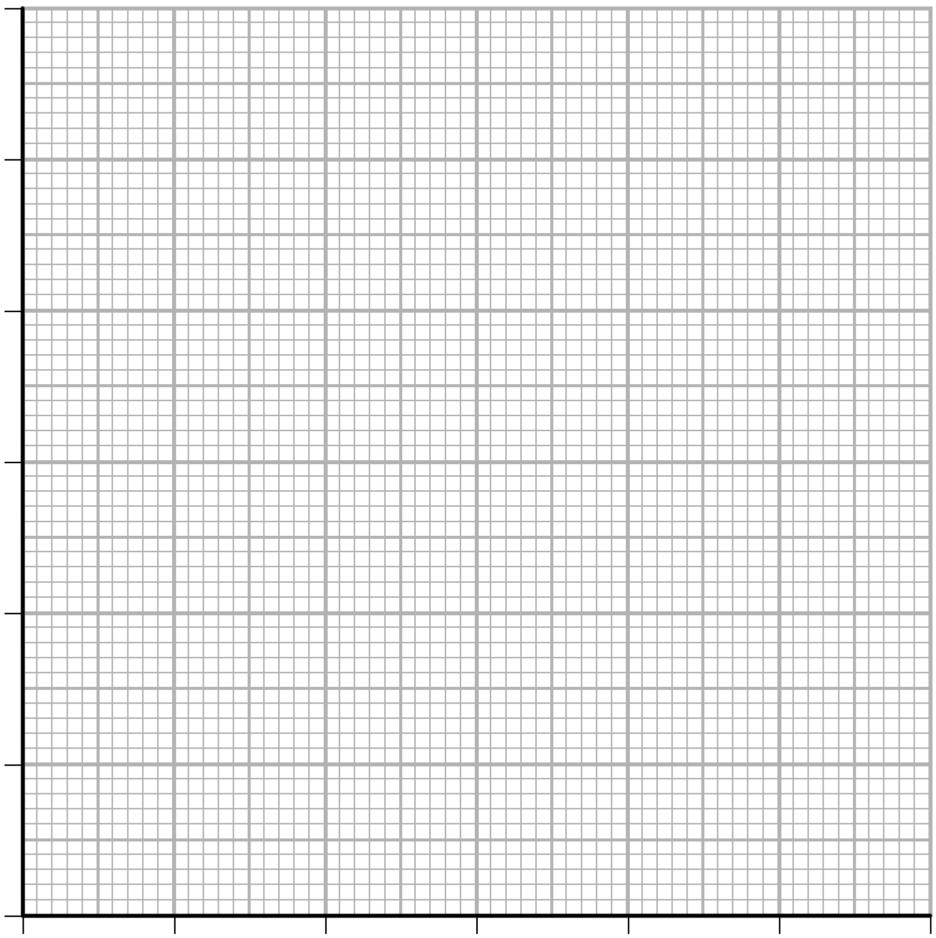
The results are shown in Figure 23.

weight (N)	extension (mm)
0.20	4.0
0.40	8.0
0.60	12.0
0.80	16.0
1.00	20.0
1.20	24.0

Figure 23

(i) Draw a graph for the readings, using the grid shown.

(3)



(ii) The student writes this conclusion:

'*The extension of the spring is directly proportional to the weight stretching the spring.*'

Comment on the student's conclusion.

(3)

(c) The student extends the investigation by finding information about the stretching of wires.

The student finds the graph shown in Figure 24 for the stretching of a wire.

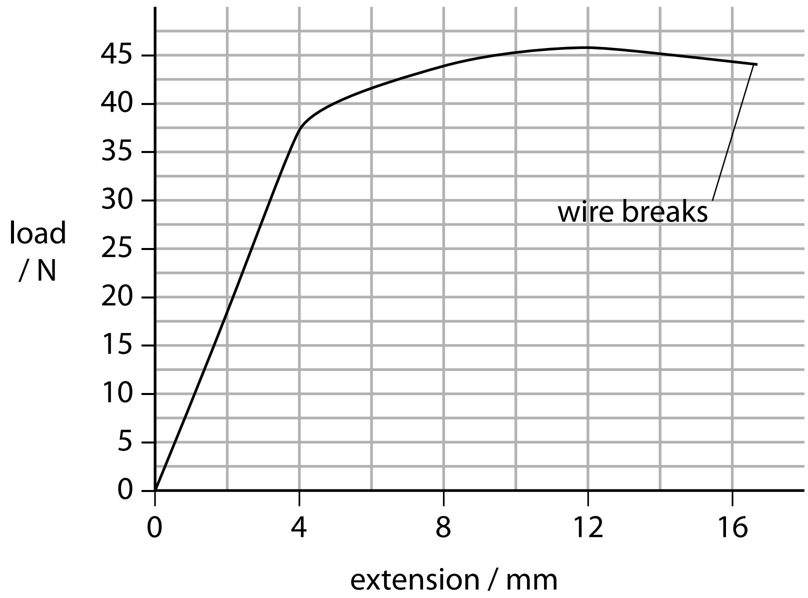


Figure 24

Describe the non-linear stretching of the wire shown in Figure 24.

(3)

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(Total for Question 9 = 11 marks)

3 A student uses a digital calliper to measure the length of a spring, as shown in Figure 10.

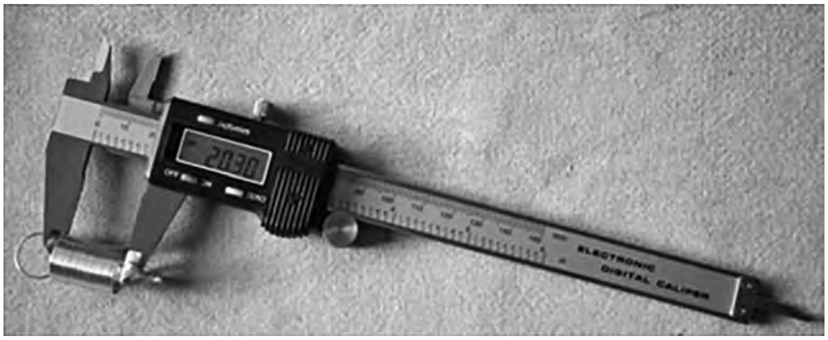


Figure 10

The spring is bendy and difficult to measure.

The student takes the six readings shown in Figure 11.

Figure 11

(a) Calculate the average length of the spring.

(2)

average length = ... mm

(b) The student investigates the stretching of a spring with the equipment shown in Figure 12.

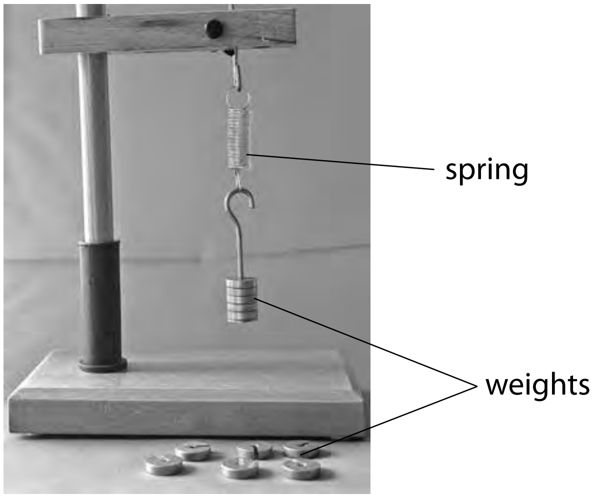


Figure 12

The student investigates the extension of the spring using six different weights.

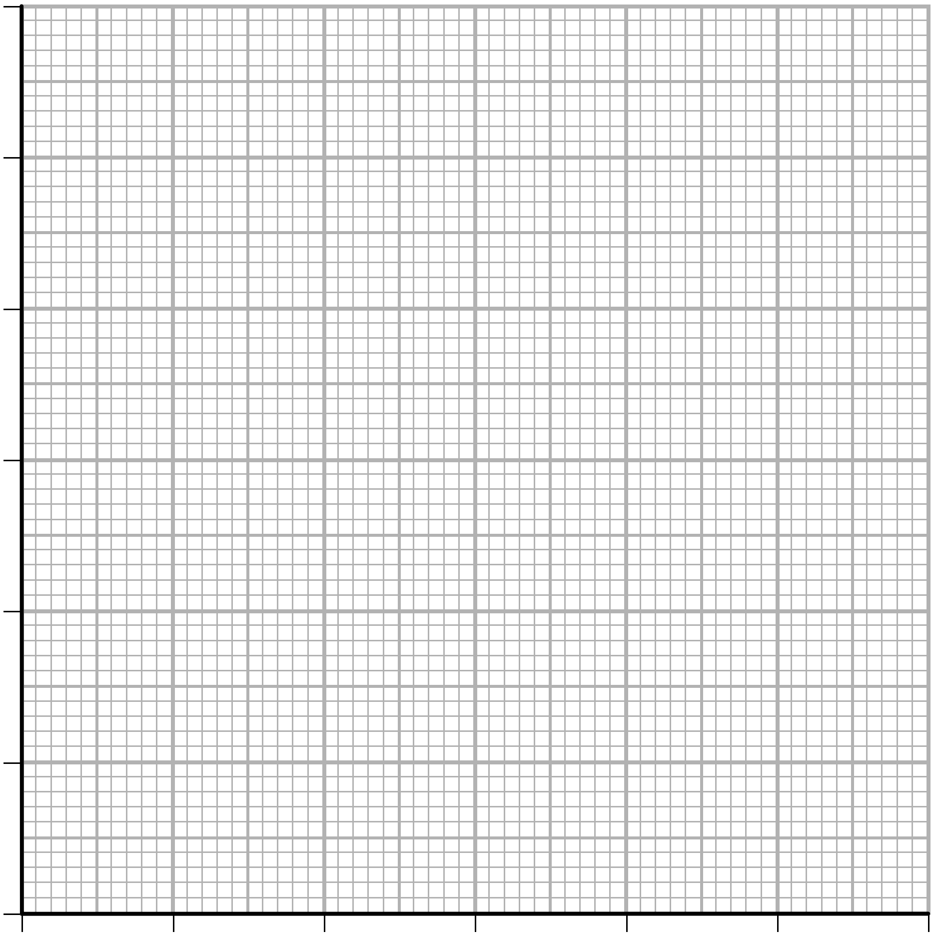
The results are shown in Figure 13.

weight (N)	extension (mm)
0.20	4.0
0.40	8.0
0.60	12.0
0.80	16.0
1.00	20.0
1.20	24.0

Figure 13

(i) Draw a graph for the readings, using the grid shown.

(3)



(ii) The student writes this conclusion:

'*The extension of the spring is directly proportional to the weight stretching the spring.*'

Comment on the student's conclusion.

(3)

(c) The student extends the investigation by finding information about the stretching of wires.

The student finds the graph shown in Figure 14 for the stretching of a wire.

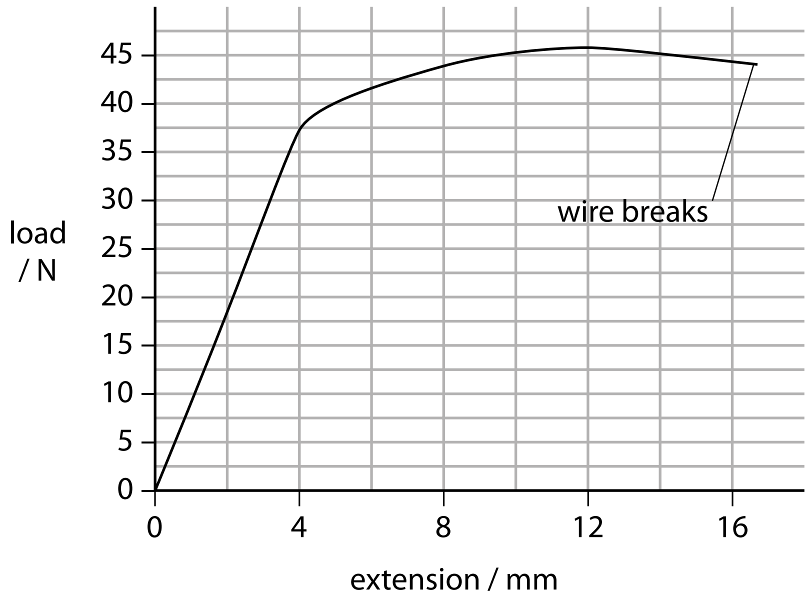


Figure 14

Describe the non-linear stretching of the wire shown in Figure 14.

(3)

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(Total for Question 5 = 11 marks)