Q1.
A weight of 4.0 N is used to extend a spring.
The extension of the spring is 0.06 m.
(i) Calculate the spring constant, *k*, of the spring.
Use the equation

$$F = k \times x$$

(3)

State what measurements should be made to determine the extension of the spring produced by the 4.0 N weight.

(2)

Q2.
Another spring has a spring constant of 250 N/m.
Calculate the work done in stretching the spring by 0.30 m.
State the unit.
Use the equation

$$E = \frac{1}{2} \times k \times x^2$$

(3)

Q3.

Figure 3 shows a toy used to launch a ball.

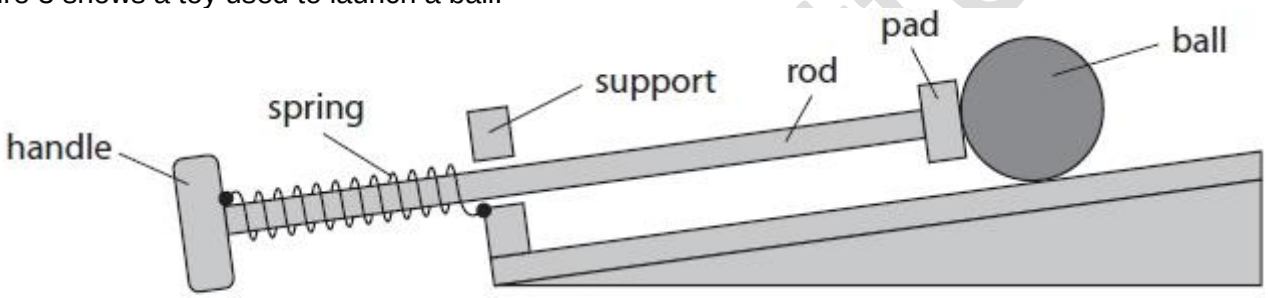


Figure 3

One end of the spring is fixed to the handle.
The other end of the spring is fixed to the support.
The child pulls the handle until the pad is against the support as shown in Figure 5.

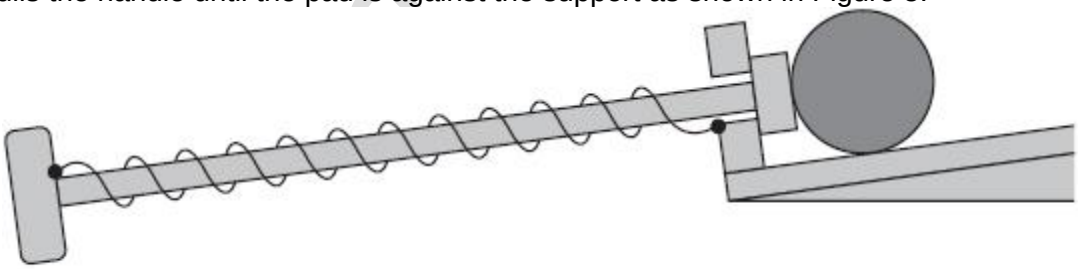


Figure 5

(i) The extension of the spring is 0.09 m.
The spring constant (*k*) is 20 N/m.
Calculate the work done in extending the spring by 0.09 m.
Use the equation

$$\text{work done} = \frac{1}{2} \times k \times (\text{extension})^2$$

(2)

(ii) The child lets go of the handle.
The ball starts to move.
The spring returns to its original length.
Describe the energy transfer that takes place when the ball starts to move.

(2)

(iii) The child can only stretch the spring until the pad is pressing against the support.

Explain how the design of the toy prevents the spring from becoming damaged.

(2)

Q4.
Figure 4 shows a 10 N weight hanging from a spring.

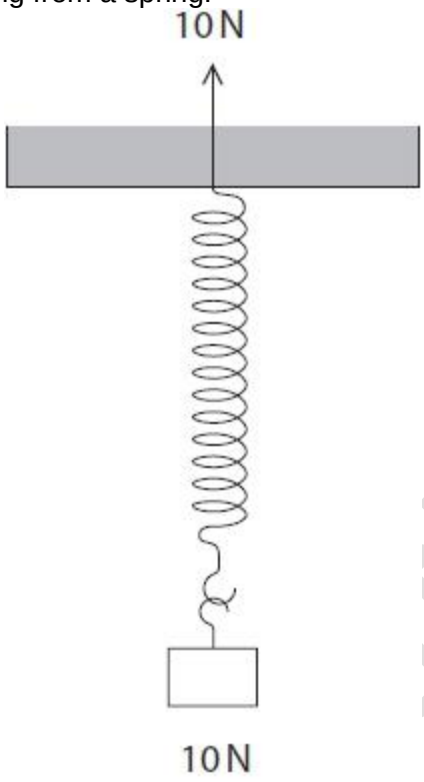


Figure 4

One of the forces acting to stretch the spring is shown in Figure 4.
Complete Figure 4 by adding an arrow to show the other force acting to stretch the spring.

Q5.
A student investigates the stretching of a spring with the equipment shown in Figure 22.

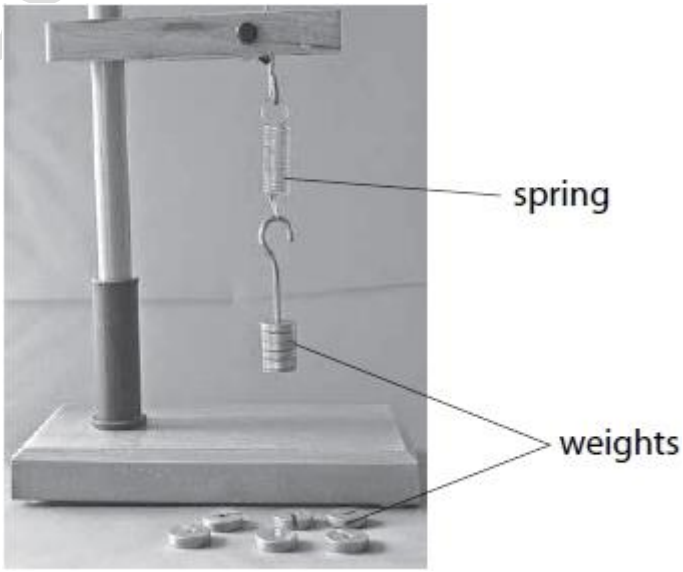
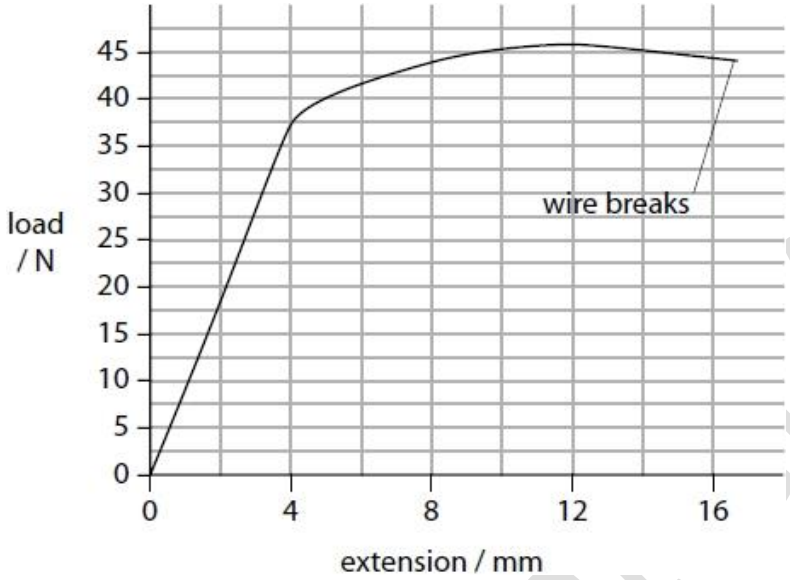


Figure 22

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.



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

(3)

Q6.
The student measures the extension of the spring as he adds different loads (loading).
He then measures the extension of the spring as he takes the loads off (unloading).
He then repeats the investigation using a rubber band instead of the spring.
The tables in Figure 4 show his results.

spring		
load in N	extension in mm	extension in mm
	loading	unloading
0	0	0
1	20	20
2	40	40
3	60	60

rubber band		
load in N	extension in mm	extension in mm
	loading	unloading
0	0	0
1	14	25
2	33	42
3	60	60

Figure 4

State **two** similarities and **two** differences between the results for the spring and the results for the rubber band.

(4)

Similarity 1

.....

.....

Similarity 2

.....

.....

Difference 1

.....

.....

Difference 2

.....

.....

Q7.

Figure 3 shows a toy used to launch a ball.

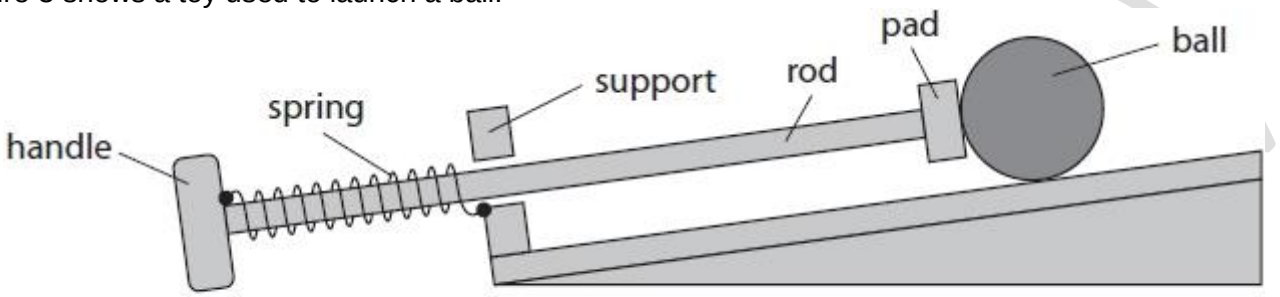


Figure 3

One end of the spring is fixed to the handle.
The other end of the spring is fixed to the support.
A child pulls the handle, stretching the spring.
Figure 4 shows the toy with the spring stretched.

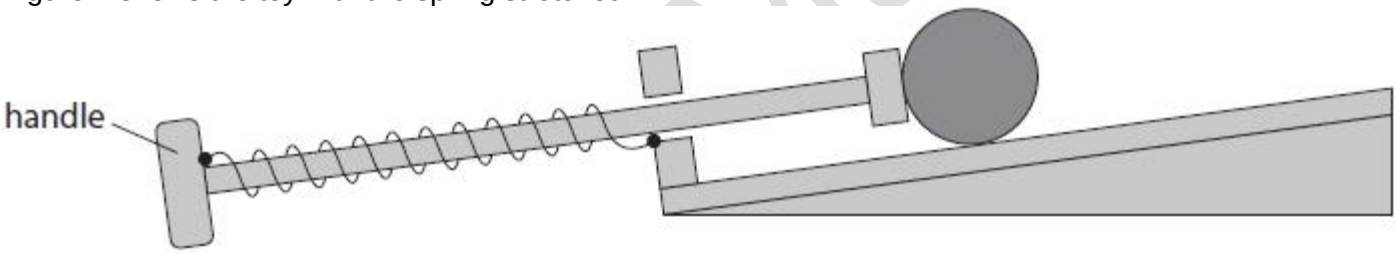


Figure 4

(i) Which of these shows the forces acting on the handle when the child keeps the spring stretched?
Ignore the force due to gravity.

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(ii) In Figure 4, the extension of the spring is 0.070 m.
The spring constant (k) is 20 N/m.
Calculate the force used to extend the spring.
Use the equation

force = k × extension

(2)

Q8.

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

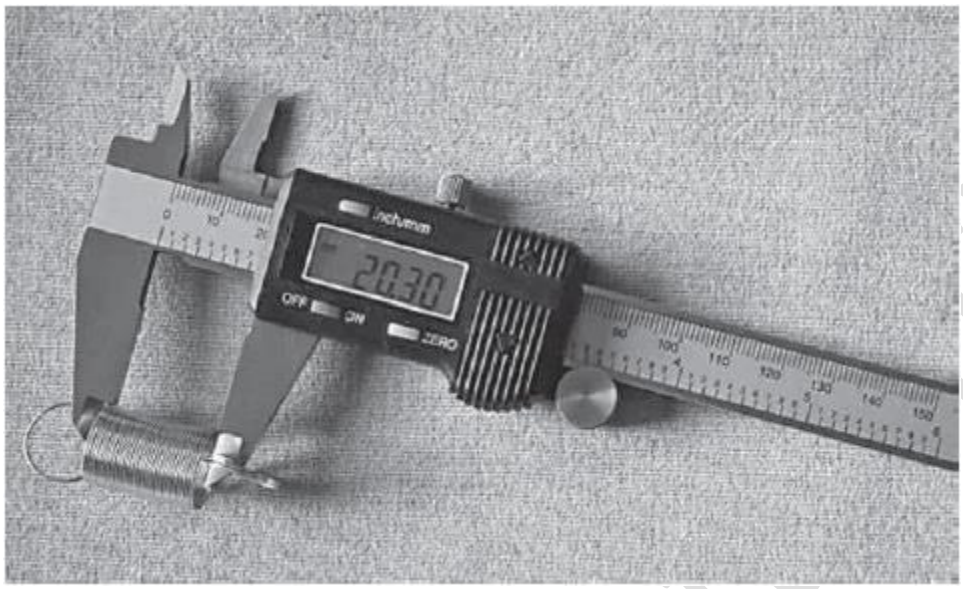


Figure 20

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)

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

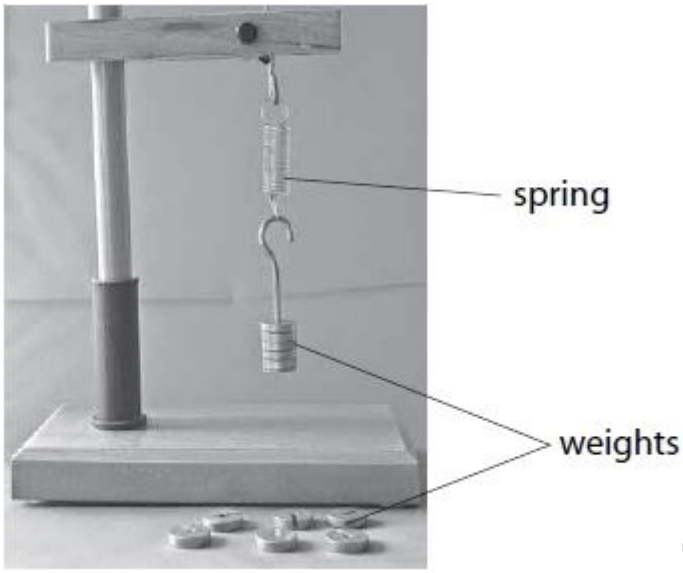


Figure 22

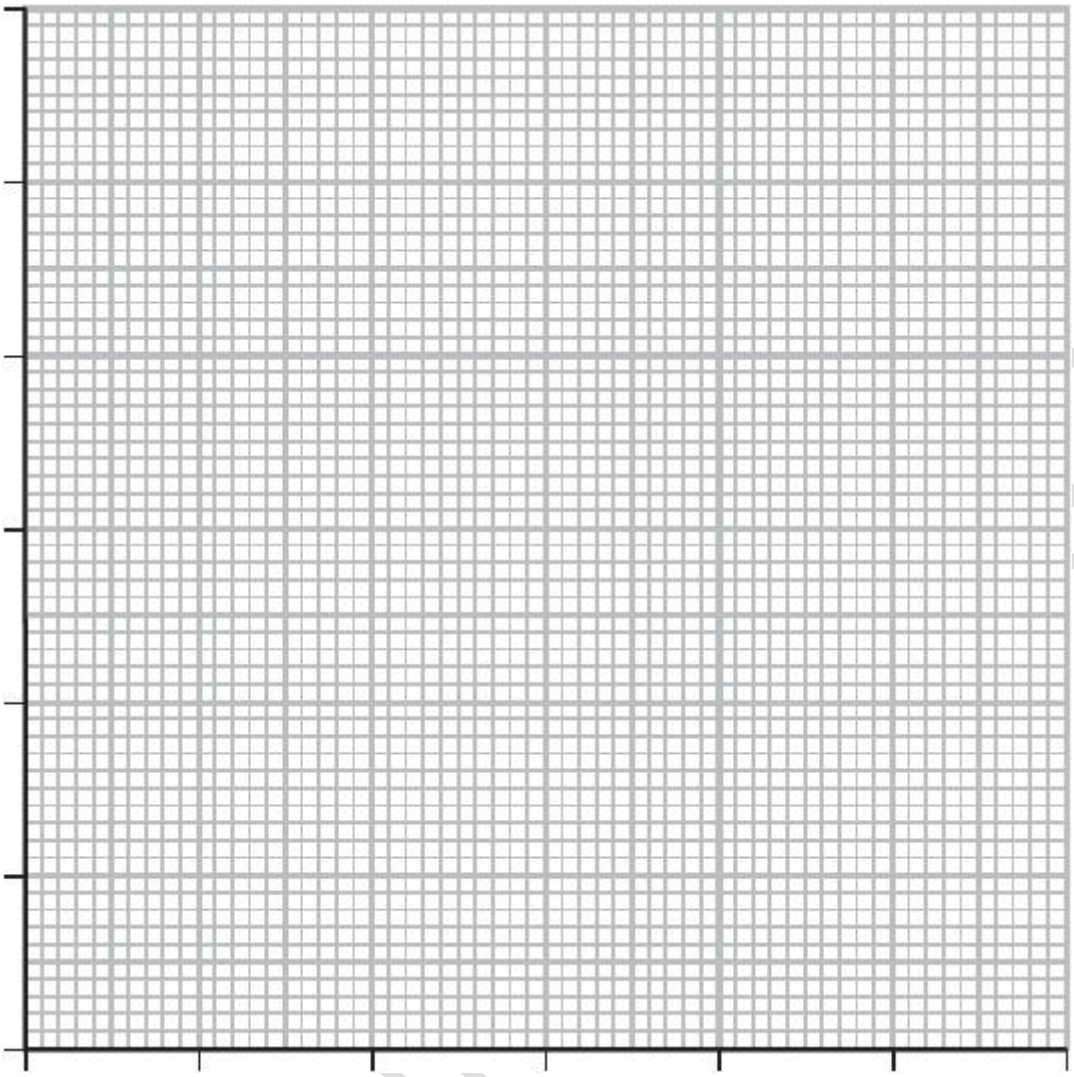
The student investigates the extension of the spring using six different weights.
The results are shown in Figure 23.

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)

Q9.
A student uses the apparatus shown in Figure 3 to investigate the extension of a spring.

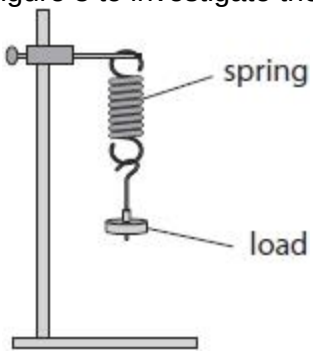


Figure 3

(i) Describe how the student could measure the extension of the spring when a load is added.

(3)

(ii) The extension of the spring for a load of 1.5 N is 30 mm.
Calculate the spring constant for the spring.
Use the equation

$$\text{spring constant} = \frac{\text{load}}{\text{extension}}$$

(2)