

Q1.a)(2018)

A student carried out an investigation to determine the spring constant of a spring.

Table 4 gives the data obtained by the student.

Table 4

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

Describe a method the student could have used to obtain the data given in **Table 4**.

Your answer should include any cause of inaccuracy in the data.

Your answer may include a labelled diagram.

[6 marks]

b)

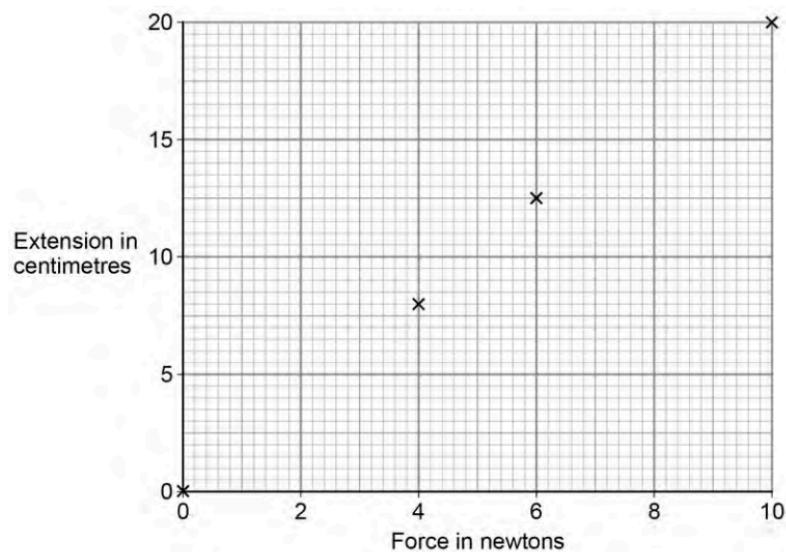
The student measured the extension for five different forces rather than just measuring the extension for one force.

Suggest why.

[1 mark]

c)

Figure 15 shows some of the data obtained by the student.

Figure 15

Complete **Figure 15** by plotting the missing data from **Table 4**.

Draw the line of best fit.

Table 4 is repeated here to help you answer this question.

[2 marks]

Table 4

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

d)

Write down the equation that links extension, force and spring constant.

[1 mark]

e)

Calculate the spring constant of the spring that the student used.

Give your answer in newtons per metre.

[4 marks]

Spring constant = _____ N/m

Q1.f)(2018)

Hooke's Law states that:

'The extension of an elastic object is directly proportional to the force applied, provided the limit of proportionality is not exceeded.'

The student concluded that over the range of force used, the spring obeyed Hooke's Law.

Explain how the data supports the student's conclusion.

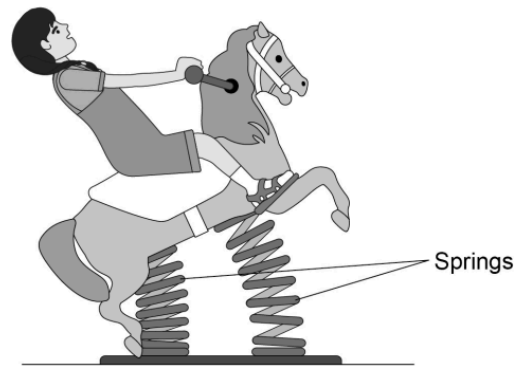
[2 marks]

Q2.(2021)

a)

Figure 20 shows a child on a playground toy.

Figure 20



The springs have been elastically deformed.

Explain what is meant by 'elastically deformed'.

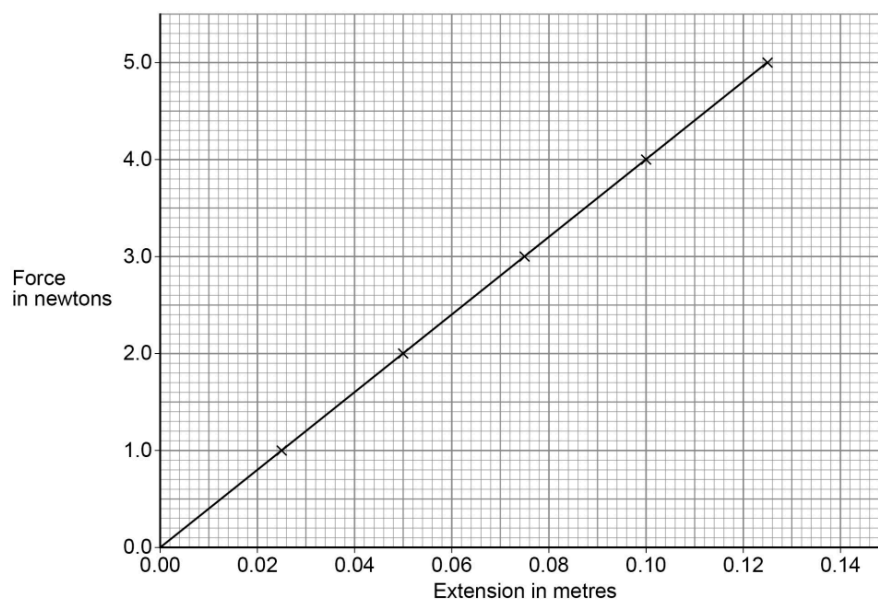
[2 marks]

b)

A student investigated the relationship between the force applied to a spring and the extension of the spring.

Figure 21 shows the results.

Figure 21



Describe a method the student could use to obtain the results given in **Figure 21**.

You should include a risk assessment for **one** hazard in the investigation.

Your answer may include a diagram.

[6 marks]

c)

Which equation links extension (e), force (F) and spring constant (k).

[1 mark]

Tick (✓) **one** box.

force = spring constant $\times$ (extension)²

☐

force = spring constant $\times$ extension

☐

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

☐

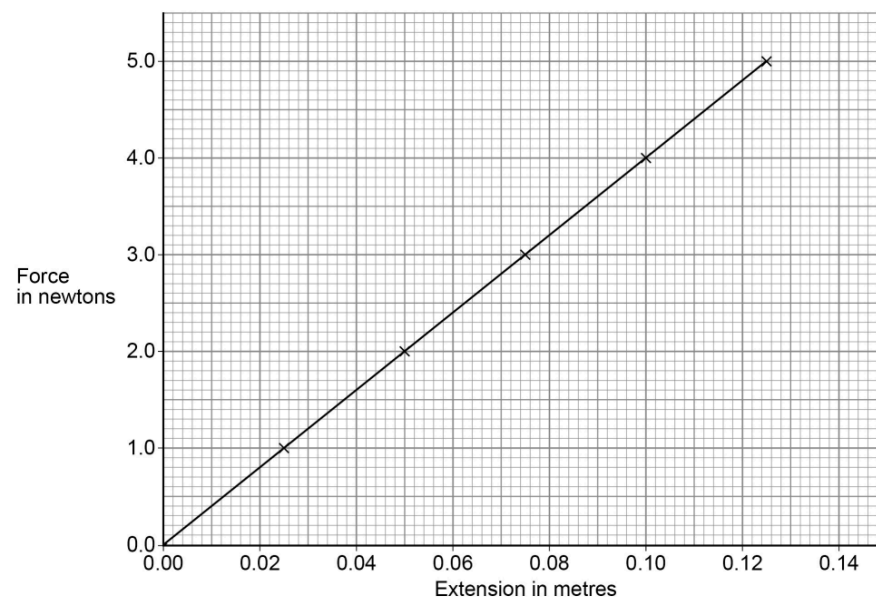
force = $\frac{\text{spring constant}}{\text{extension}}$

☐

d)

Figure 21 is repeated below.

Figure 21



Determine the spring constant of the spring.

Use **Figure 21**.

[3 marks]

Spring constant = _____ N/m

e)

The student concluded:

'The extension of the spring is directly proportional to the force applied to the spring.'

Describe how **Figure 21** supports the student's conclusion.

[2 marks]

f)

The student repeated the investigation using a different spring with a spring constant of 13 N/m.

Calculate the elastic potential energy of the spring when the extension of the spring was 20 cm.

Use the Physics Equations Sheet.

[3 marks]

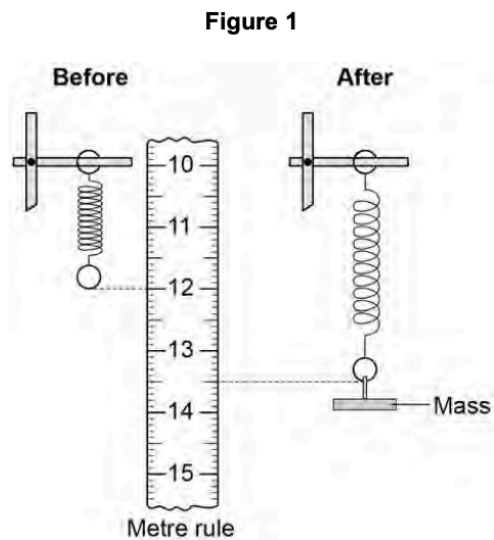
Elastic potential energy = _____ J

Q3.(2023)

a)

A student carried out an investigation to determine the spring constant of a spring.

Figure 1 shows the spring before and after a mass was hung from the end of the spring.



What is the extension of the spring in **Figure 1**?

[1 mark]

Tick (✓) **one** box.

1.5 cm

☐

3.5 cm

☐

13.5 cm

☐

b)

Give **one** safety precaution the student should have taken during this investigation.

[1 mark]

c)

The student hung a mass of 0.050 kg from the spring.

gravitational field strength = 9.8 N/kg

Calculate the weight of the 0.050 kg mass.

Use the equation:

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

[2 marks]

Weight = _____ N

d)

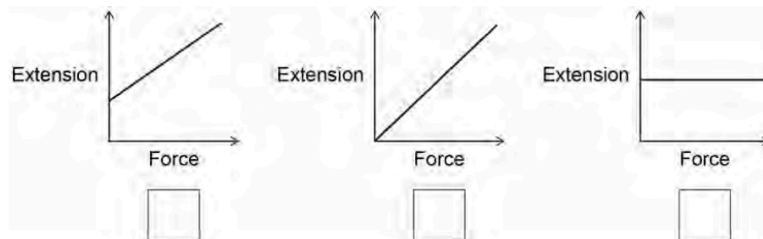
The weight of the mass applies a force to the spring.

The student added more masses and recorded the extension of the spring.

Which graph in **Figure 2** shows the relationship between the force applied to the spring and the extension of the spring?

[1 mark]

Tick (✓) **one** box.

Figure 2

e)

A force of 2.0 N was applied to a different spring.

The extension of the spring was 0.080 m.

Calculate the spring constant of the spring.

Use the equation:

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

[2 marks]