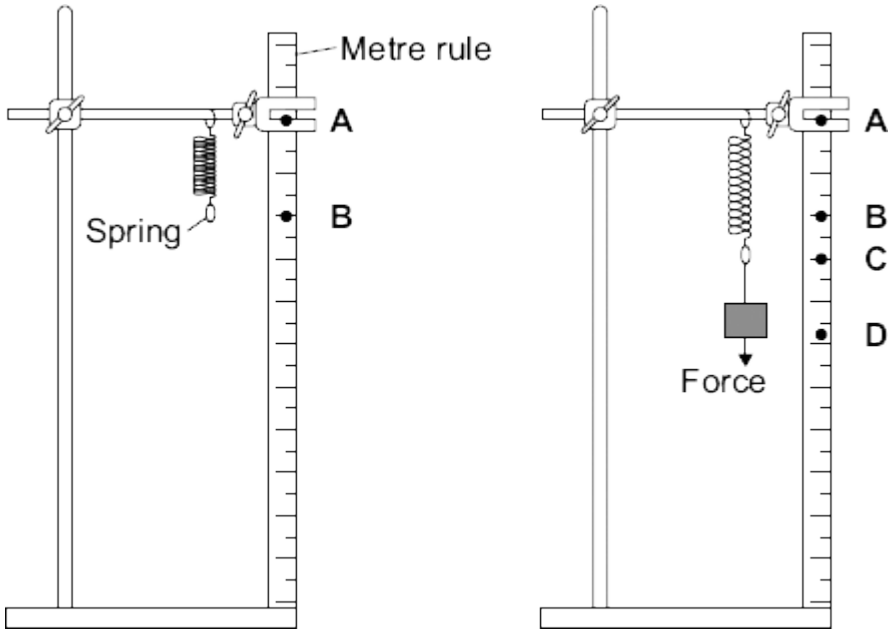
Q1.

A student investigated how the extension of a spring depends on the force applied to the spring.

The diagram shows the spring before and after a force had been applied.



(a) (i) Complete the following sentence using letters, **A**, **B**, **C** or **D**, from the diagram.

The extension of the spring is the distance between the positions labelled

_____and _____ on the metre rule.

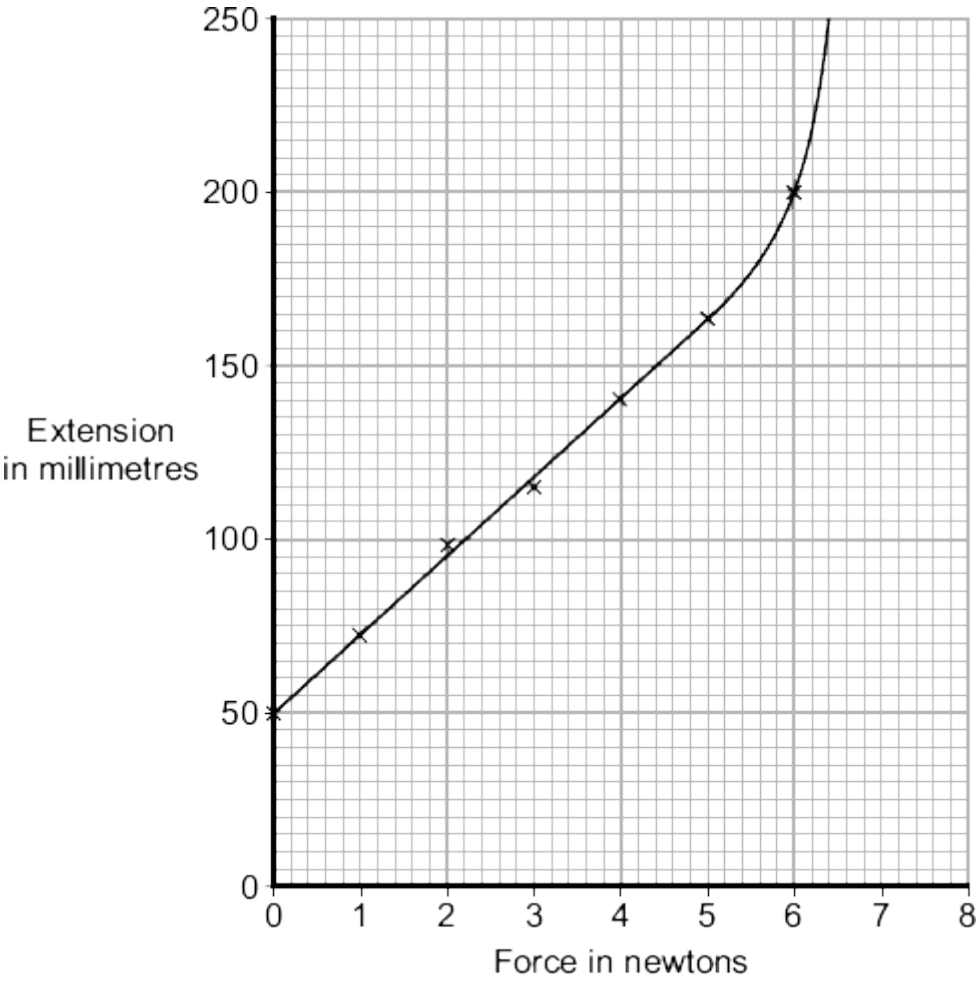
(1)

(ii) What form of energy is stored in the stretched spring?

_____

(1)

(b) The results from the investigation are plotted on the following graph.



(i) The graph shows that the student has made an error throughout the investigation.

What error has the student made?

_____

_____

Give the reason for your answer.

_____

_____

(2)

(ii) The student has loaded the spring beyond its *limit of proportionality*.

Mark on the graph line the *limit of proportionality* of the spring. Label the point **P**.

Give the reason for choosing your point **P**.

_____

_____

_____

(2)

(c) The student uses a different spring as a spring balance. When the student hangs a stone from this spring, its extension is 72 mm.

The spring does not go past the limit of proportionality.

Calculate the force exerted by the stone on the spring.

spring constant = 25 N/m

Show clearly how you work out your answer.

_____

_____

Force = _____ N

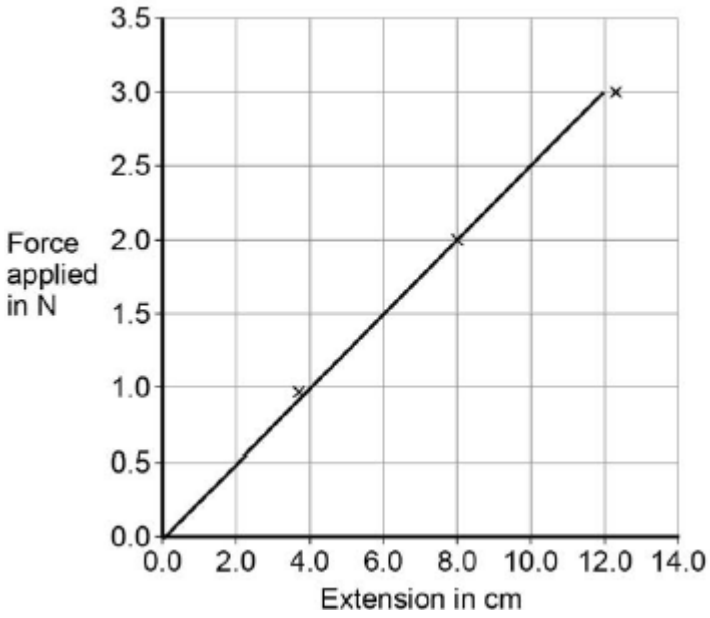
(2)

(Total 8 marks)

Q2.

A student changed the force applied to a spring by adding weights.

The figure below shows a graph of her results.



(a) Write down the equation that links the force applied and extension for a spring.

_____

(1)

(b) Identify the pattern shown in the figure above.

Explain your answer.

_____

_____

_____

(2)

(c) Give **one** way the student could improve her investigation.

(1)

(d) Describe the relationship between work done and elastic potential energy in stretching a spring.

(2)

(e) Draw a line on the figure above to show the results for a stiffer spring.

Explain the reason for the line you have drawn.

(3)

(f) Explain what would happen to the spring if the student kept adding weights?

(2)

(Total 11 marks)

Mark schemes

Q1.

(a) (i) **B C**

either order

1

(ii) elastic <u>potential</u> (energy)

accept strain for elastic

1

(b) (i) *mark both parts together*

1

measured / recorded the length of the spring (and not extension)

*accept measured **A–C** (and not **B–C**)*

accept did not work out/measure the extension

extension does not equal zero when force = 0

accept line should pass through the origin

1

(ii) point marked at 5.5 (N)

accept any point between 5.0 and 5.6 inclusive

1

up to that point force and extension are (directly) proportional

accept it's at the end of the straight part (of the graph line)

accept past that point force and extension are no longer (directly) proportional

accept the line starts to curve

1

(c) 1.8

*allow **1** mark for correct substitution, ie 25 x 0.072 provided no subsequent step shown*

*an answer 1800 gains **1** mark*

*an incorrect conversion from mm to m with a subsequent correct calculation gains **1** mark*

2

[8]

Q2.

(a) force = spring constant × extension

accept f = ke

1

(b) extension is directly proportional to the force applied

1

because it is straight line through the origin

1

(c) test a greater range of load

or

test more springs

1

(d) work done is equal to elastic potential energy

1

as long as the spring does not go past the limit of proportionality

1

(e) line extending with a greater gradient than existing line

1

a stiffer spring has a greater spring constant (*k*)

1

k = F / e

1

(f) the spring will be deformed

accept not gone back to original shape

1

because it has passed the elastic limit

1

[11]