HOOKE'S LAW

Specification

Describe experiments to investigate how extension varies with applied force for helical springs, metal wires and rubber bands

understand that the initial linear region of a force-extension graph is associated with Hooke's law
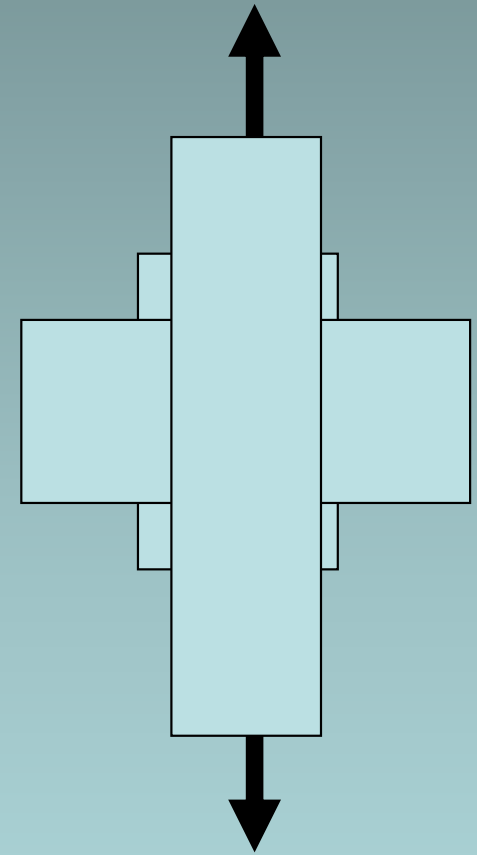
describe elastic behaviour as the ability of a material to recover its original shape after the forces causing deformation have been removed.

Changing shape

Force can also change the shape of an object.

A stretching force puts an object such as a wire or spring under **tension**.

A squashing force puts an object under **compression**.

Brittle materials such as glass do not change shape easily and break before noticeably stretching.

Resilient materials do not break easily.

Elastic materials return to their original shape when the forces on them are removed.


Plastic materials retain their new shape.

Stretching Springs
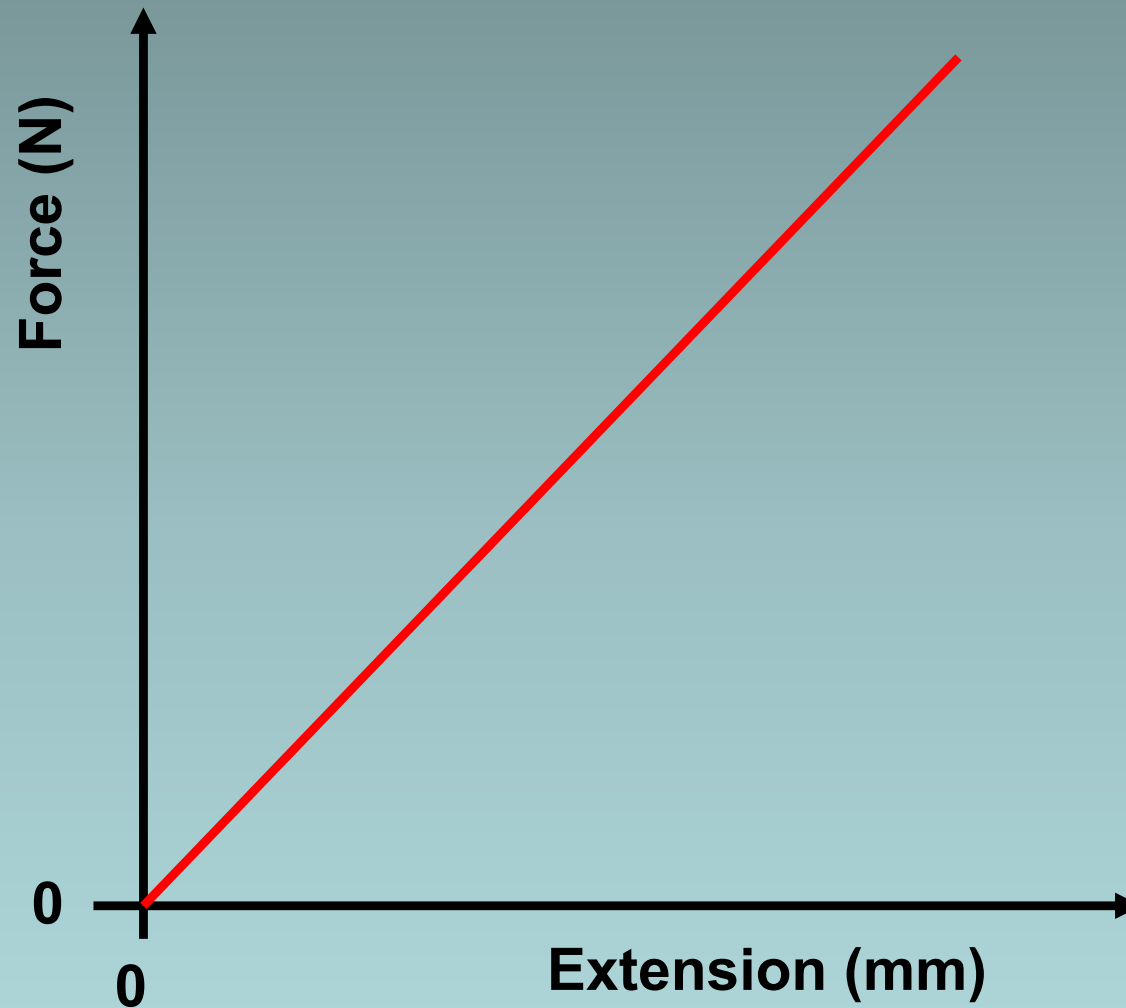
Experimental procedure:

1. Place the weight holder only on the spring and note the position of the pin against the metre rule.

2. Add 1N (100g) to the holder and note the new position of the pin.

3. Calculate the extension of the spring.

4. Repeat stages 1 to 3 for 2N, 3N, 4N, 5N and 6N. **DO NOT EXCEED 6N.**

spring

weights

pin

metre rule
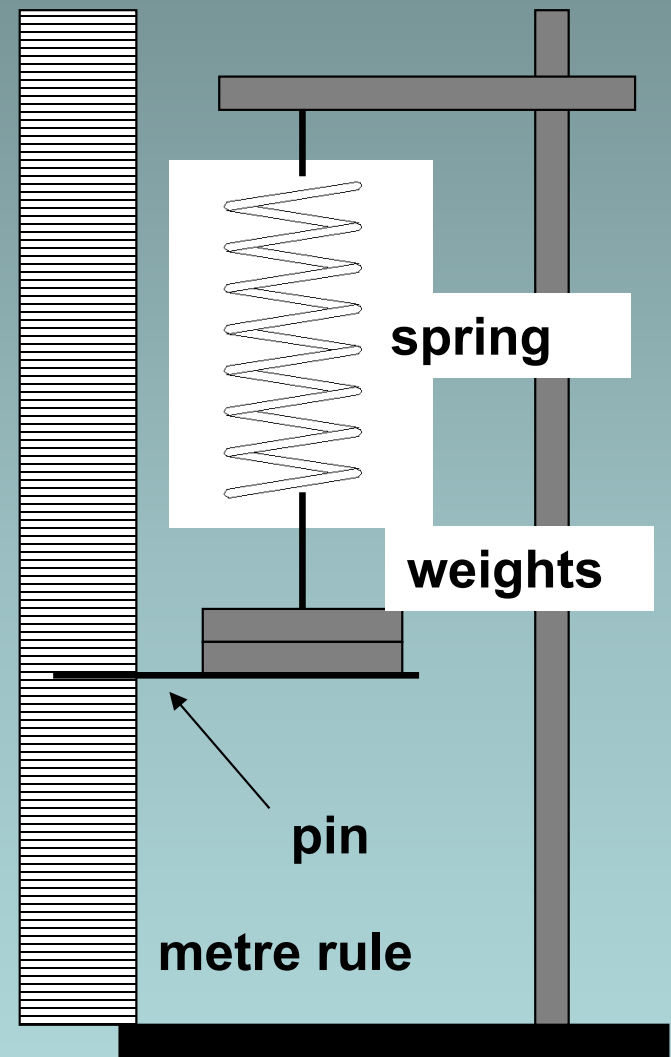
Typical results

Pin position with holder only (mm)	Added weight or Force (N)	Pin position with weight (mm)	Extension (mm)
450	2	509	59
450	3	541	91
450	4	570	120
450	5	601	151
450	6	629	179

Force against extension graph

Hooke's law

Hooke's law states that the extension of a spring is proportional to the force used to stretch the spring.

'**Proportional**' means that if the force is doubled then the extension also doubles.

The line on a graph of force against extension will be a straight **AND** go through the origin.

Question

A spring of original length 150mm is extended by 30mm by a force of 4N. Calculate the length of the spring if a force of 12N is applied.

Question

A spring of original length 150mm is extended by 30mm by a force of 4N. Calculate the length of the spring if a force of 12N is applied.

12N is three times 4N

Therefore the new extension should be 3 x 30mm

= 90mm

New spring length = 150mm + 90mm

= 240mm

Elastic limit

Up to a certain extension if the force is removed the spring will return to its original length. The spring is behaving **elastically**.
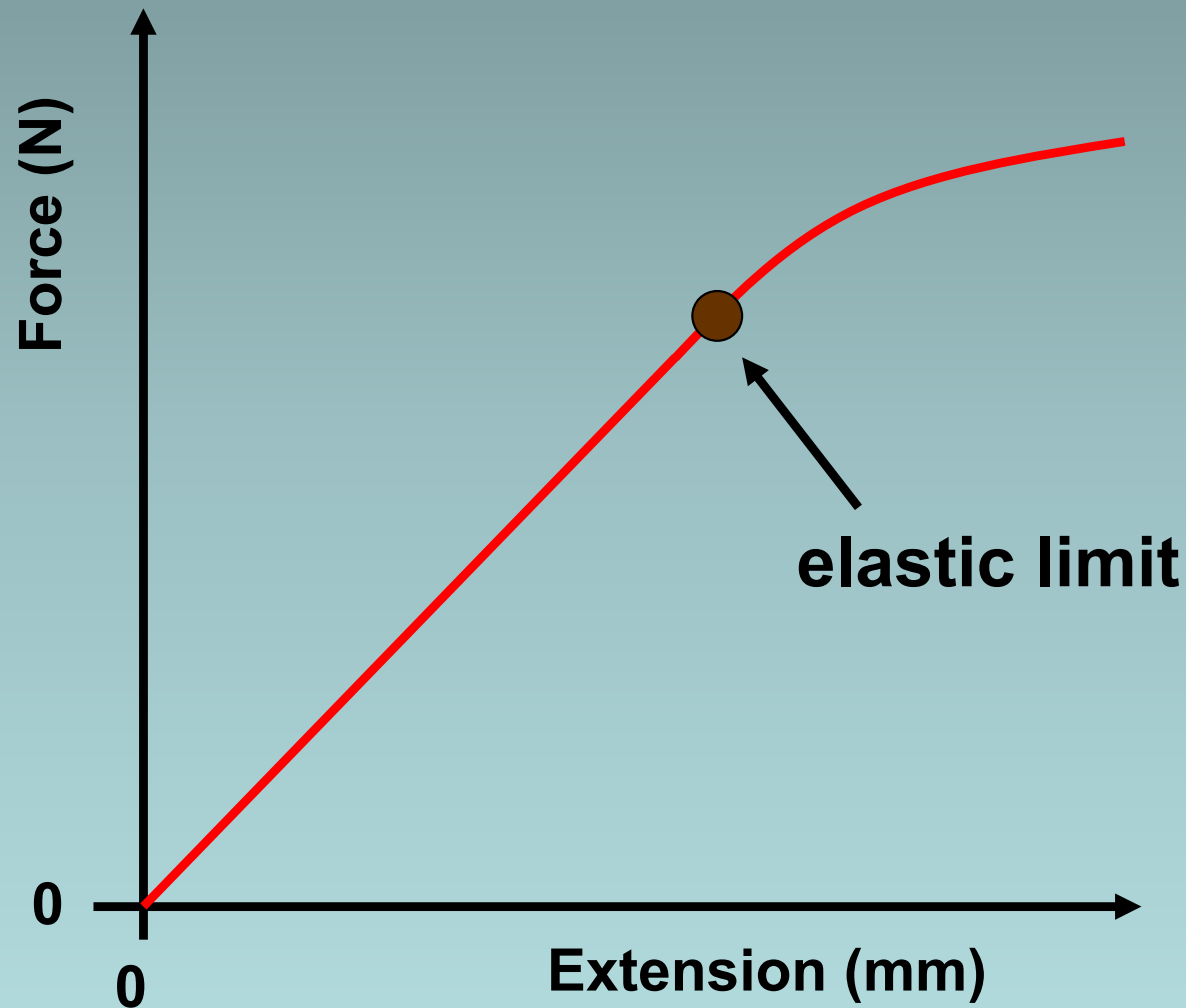
If this critical extension is exceeded, known as the **elastic limit**, the spring will be permanently stretched.

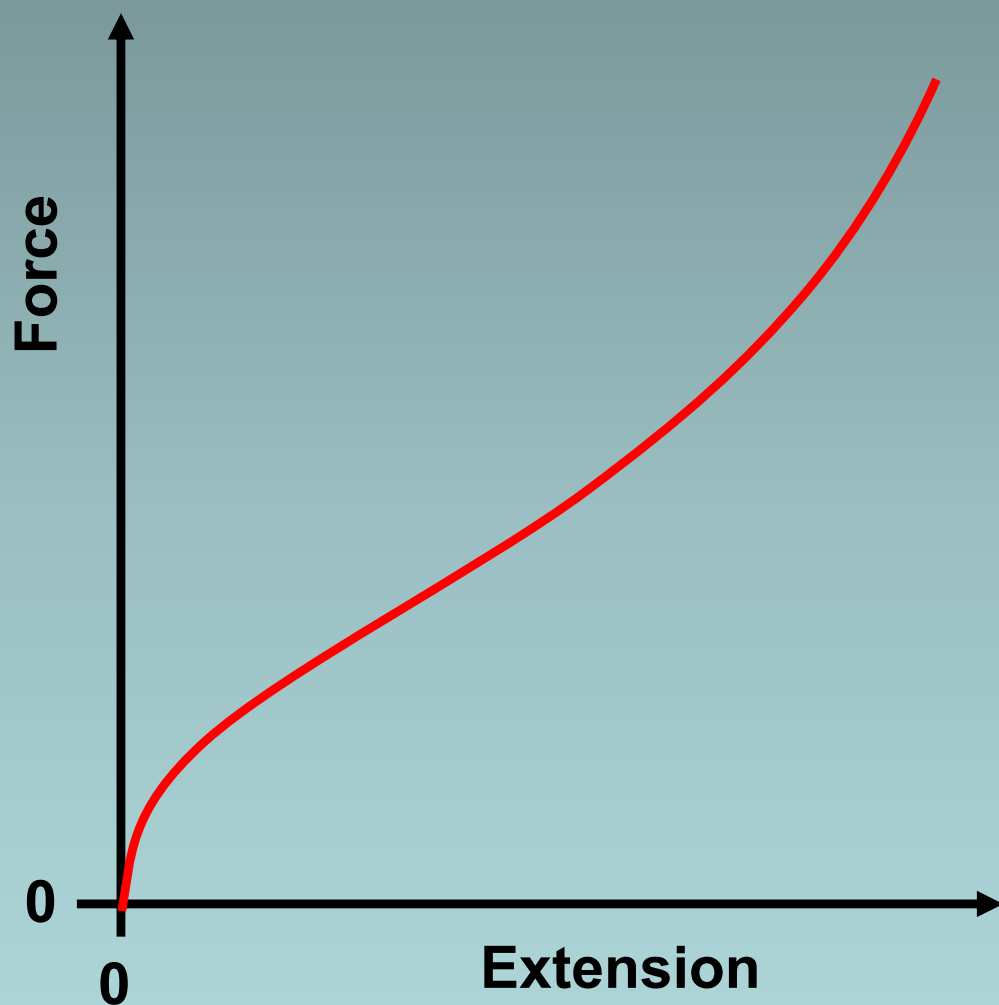Hooke's law is no longer obeyed by the spring if its elastic limit is exceeded.

The right hand spring has been stretched beyond its elastic limit

Force against extension graph if the elastic limit is exceeded

elastic limit

Force (N)

0

0

Extension (mm)

Stretching an elastic band

An elastic band does not obey Hooke's law.

Choose appropriate words to fill in the gaps below:

Hooke's law states that when a wire or spring is _____ the increase in length or _____ is proportional to the load _____ applied.

This law is not obeyed if the spring is taken beyond its _____ limit after which it will become _____ stretched.

A _____ band does not obey Hooke's law.

A graph illustrating Hooke's law will have a line that is _____ and passes through the _____.

WORD SELECTION:

stretched   elastic   permanently   extension

origin force rubber straight

Choose appropriate words to fill in the gaps below:

Hooke's law states that when a wire or spring is __stretched__ the increase in length or __extension__ is proportional to the load __force__ applied.

This law is not obeyed if the spring is taken beyond its __elastic__ limit after which it will become __permanently__ stretched.

A __rubber__ band does not obey Hooke's law.

A graph illustrating Hooke's law will have a line that is __straight__ and passes through the __origin__.

WORD SELECTION:

stretched   elastic   permanently   extension

origin   force   rubber   straight