Stretching

When you pull a spring, it gets longer.

The extra length is called extension and is measured in cm or m.

If it goes back to its original length when you let it go, it is elastic.

1 A new spring is 6.0 cm long. You pull it, and it is now 8.0 cm long.

(a) Calculate the extension.

(b) You now pull it harder, and make it 10.0 cm long. What is the extension now?

(c) When you let it go, it is now 6.4 cm long. Was the stretch elastic?

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2 An athlete trains using a chest expander.
The table shows the force needed to stretch it.

Force (N)	0	50	100	150	200	250
Length (cm)	42.5	46.5	50.5	54.5		62.5
Extension (cm)	0.0		8.0			20.0

(a) How long was the chest expander before they stretched it?

(b) Fill in the missing length.

(c) Fill in the row with the extensions.

(d) What happens to the spring's length when you increase the force by 100 N?

(e) How much extra force is needed to make it 1 cm longer?

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3 A spring gets 1 cm longer each time the force is made 4 N larger.

(a) Calculate the force needed to make the spring 7 cm longer.

(b) Calculate the force needed to make the spring 10 cm longer.

(c) Put a number in the box: force (N) $=$ $\square$ $\times$ extension (cm).

A spring constant of 3 N/cm means that it takes 3 N to make the spring 1 cm longer.

4 A spring has a 3 N/cm spring constant.

(a) How much force is needed to stretch it 4 cm? Use the equation

force (N)	=	spring constant (N/cm)	×	extension (cm)
	=	3	×	4

(b) How much force is needed to stretch it 11 cm? Use the equation

force (N)	=	spring constant (N/cm)	×	extension (cm)
	=	3	×	11

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5 A spring has a 5 N/cm spring constant.

(a) How far will a 30 N force stretch it? Use the equation

force (N)	=	spring constant (N/cm)	×	extension (cm)
30	=	5	×	

(b) How far will a 45 N force stretch it? Use the equation

force (N)	=	spring constant (N/cm)	×	extension (cm)
45	=	5	×	

(c) Complete the word equation: extension = [ ] ÷ [ ].

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6 A spring gets 10 cm longer when stretched by a 60 N force.

(a) Force to stretch it by 1 cm = [ ] ÷ [ ] = [ ] newtons.

(b) Complete the sentence: The spring constant (in N/cm) is [ ].

(c) A different spring gets 12 cm longer when pulled with a 36 N force. Work out the spring constant using an equation.

force (N)	=	spring constant (N/cm)	×	extension (cm)
36	=		×	12

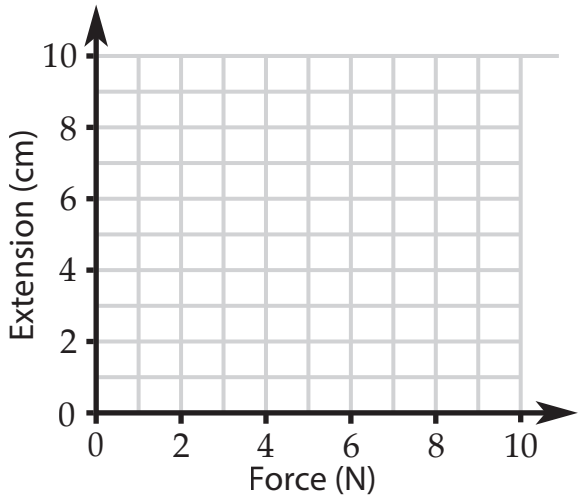
(d) Complete the word equation: spring constant = [ ] ÷ [ ].

Below the limit of proportionality, each 1 N force gives the same extra extension. The spring obeys **Hooke's law**. The line on the graph of extension and force is straight.

When a spring passes its limit of proportionality, each additional 1 N force does not give the same extra extension. The spring does not obey Hooke's law.

7 The extension of a spring for different forces is given in the table.

Force (N)	**Extension (cm)**
0.0	0.0
2.0	1.2
4.0	2.5
6.0	3.8
8.0	5.1
10.0	8.2



(a) Plot a graph of the data. Add a best fit line to your points.

(b) Label the limit of proportionality on your graph.

(c) Is the spring obeying Hooke's law with a 5 N force?

(d) If the spring were stiffer, would the line on the graph be steeper?

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8 Complete the word equations using **force**, **extension** and **spring constant**.

(a) force $=$ (b) spring constant $=$ (c) extension $=$

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9 Rewrite your word equations using symbols.
F is the force, e is the extension and k is the spring constant.

(a) $F =$ (b) $k =$ (c) $e =$

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10 Calculate the force needed to extend a $k = 20$ N/cm spring by 7.0 cm.

11 Calculate the spring constant if a 10 N force causes a 0.20 cm extension.

12 Calculate the extension caused by a 400 N force on a $k = 8$ N/cm spring.