Exercise walk-through

5.3
Forces and elasticity (4.5.3, RP6)

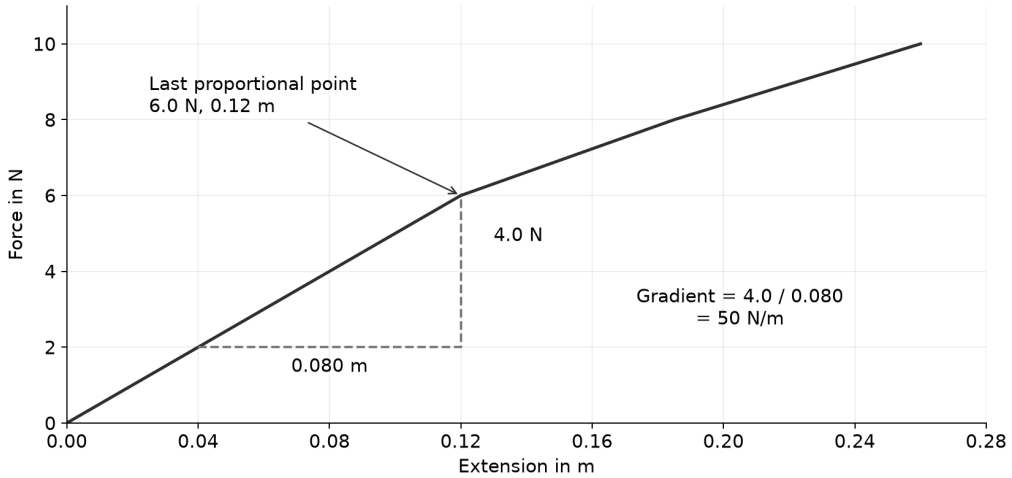
AQA · GCSE · Physics

Forces and elasticity

- To stretch, bend or squash an object that is not moving, you need more than one force; one force alone would just move it. **Elastic** deformation means the object returns to its original shape when the forces are removed. **Inelastic** deformation means it does not.
- For a spring, up to its limit of proportionality:
- F is force in N, k is the spring constant in N/m and e is the extension in m.
- A stiff spring has a large spring constant.

$$F = ke$$

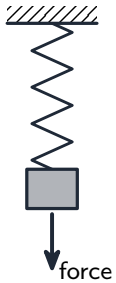
Figure: Forces and elasticity



- Required practical 6: force against extension is a straight line, then curves beyond the limit of proportionality.
- Read the axes and units first.

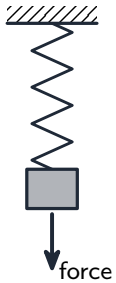
Exercise 2.1

2.1 A spring has a spring constant of 40 N/m. Calculate the force needed to stretch it by 0.15 m. [2]



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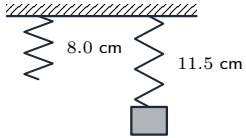


2.1

- $40 \times 0.15 = \mathbf{6.0}$ N

Exercises 2.2·2.3

2.2 A spring is 8.0 cm long. With a weight on it, it is 11.5 cm long. Calculate the extension in metres. [2]

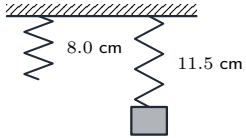


2.3 A plastic bag stretches and stays stretched. A rubber band stretches and goes back. Name the type of deformation for each. [2]



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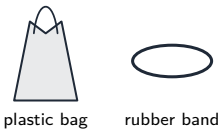
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2.2

- $11.5 - 8.0 = 3.5$ cm $= \mathbf{0.035}$ m

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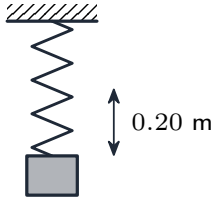
2.3

- plastic bag: inelastic (plastic) deformation; rubber band: elastic deformation

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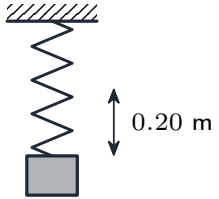
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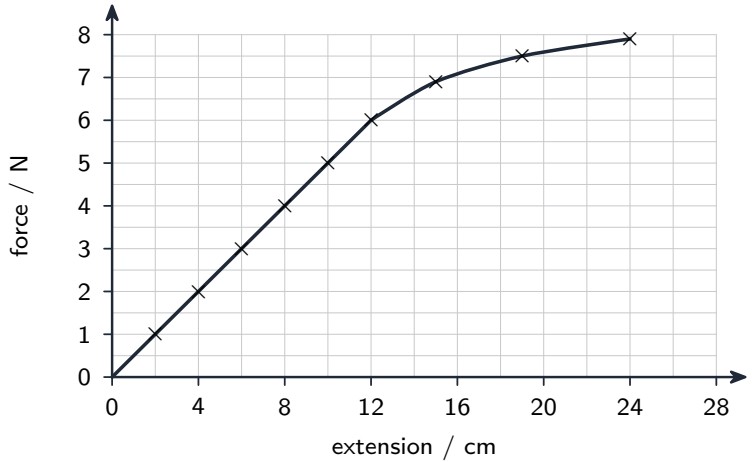
3.1

- $F = 25 \times 0.20 = 5.0$ N
- $E_e = 0.5 \times 25 \times 0.20^2$
- $E_e = \mathbf{0.50}$ J

Exercise 3.2 (a)

3.2 A student hangs weights on a spring and measures the extension. The graph shows the results.

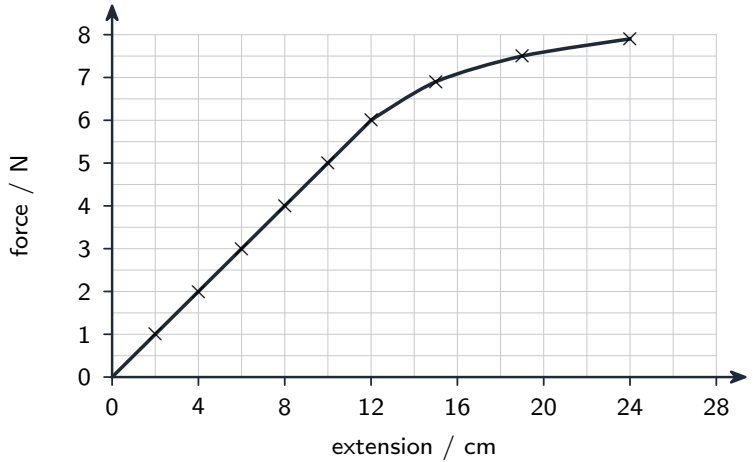
(a) Use the graph to find the extension when the force is 4.0 N. [2]



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(a) read at 4.0 N; **8.0** cm

Exercise 3.2 (b)

3.2 A student hangs weights on a spring and measures the extension. The graph shows the results.

(b) Use the straight part of the graph to calculate the spring constant in N/m. [3]

Exercise 3.2 (b)

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(b) a point on the straight part, e.g. 4.0 N at 0.080 m; $k = 4.0 \div 0.080 = \mathbf{50}$ N/m

Exercise 3.2 (c)

3.2 A student hangs weights on a spring and measures the extension. The graph shows the results.

(c) Use the graph to give the force at the limit of proportionality, and explain how you can tell. [2]

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(c) about **6.0** N; the line stops being straight and starts to curve

Exercise 3.2 (d)

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(d) Describe how the student could carry out this investigation to get accurate results. [6]

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(d) points to include:

- hang the spring from a clamp stand and fix a metre rule next to it
- measure the original length of the spring at eye level, with a pointer on the spring
- add one 1 N weight at a time and measure the new length each time
- extension = new length − original length
- wait for the spring to stop moving before reading; read at eye level to avoid parallax
- plot force against extension and draw a line of best fit; wear eye protection and keep feet away in case the spring breaks

Levels: **5–6** a full, logical answer with correct physics and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.