Forces and elasticity

Name _____ Class _____ Date _____

Springs and elastic objects stretch when forces act on them. Up to a point, the extension is **proportional** to the force.

KEY EQUATION

$$F = k\,e$$

F = force (N)
k = spring constant (N/m)
e = extension (m)
Valid up to the limit of proportionality.

WORKED EXAMPLE

A spring stretches 0.05 m with a 2 N force.
k = F ÷ e = 2 ÷ 0.05 = **40 N/m**

Section A · Recall

Grade 4–5

1 Explain the difference between elastic and inelastic deformation. [2]

Elastic: the object returns to its original shape when the force is removed.

Inelastic: it doesn't return to its original shape.

2 Why must more than one force act to stretch a spring? [1]

If only one force acted, the spring would just move (accelerate), not stretch.

3 A spring has k = 25 N/m. Calculate the force needed to stretch it by 0.2 m. [2]

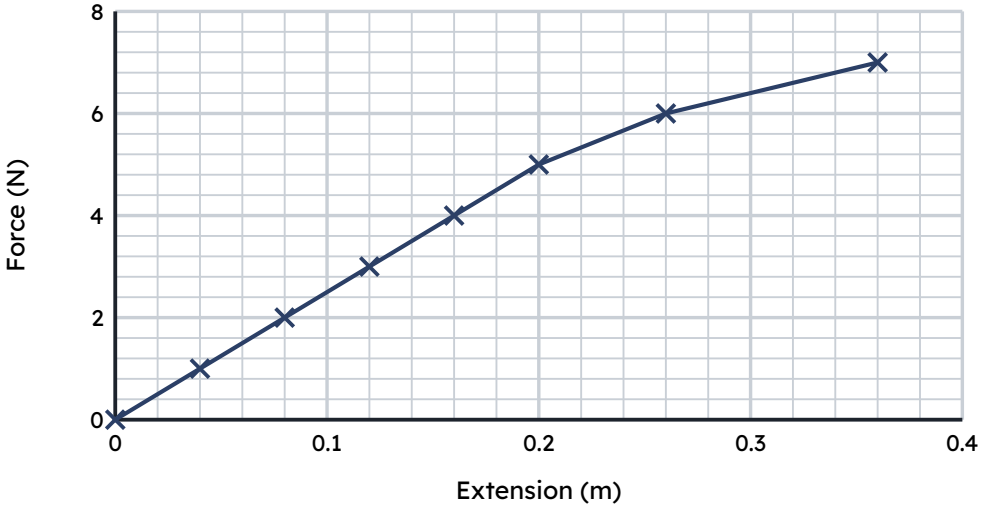
F = 25 × 0.2 = 5 N

Section B · Required practical

Grade 5–6

4 A student adds weights to a spring and measures the extension.

Force (N)	Extension (m)
0	0.00
1	0.04
2	0.08
3	0.12
4	0.16
5	0.20
6	0.26
7	0.36



a Plot the results and draw a line of best fit. [3]
Points correct (2); straight line through the origin to 5 N, then curving (1).

b Use the straight part of the graph to calculate the spring constant. [2]

k = F ÷ e = 5 ÷ 0.20

k = 25 N/m

c Describe what happens after the force reaches 5 N. [1]

The graph curves: the limit of proportionality has been passed.

Section C · Stretch

Grade 7+

5 Calculate the elastic potential energy stored in the spring when the force is 4 N. [3]

e = 0.16 m (from the table), k = 25 N/m

Ee = ½ × 25 × 0.16²

Ee = 0.32 J

Exam-style question

AQA style

6 Describe how the student could carry out the investigation to get accurate results.

[6]

Clamp the spring from a stand; place a metre rule next to it and fix a pointer to the bottom.

Measure the original length; add masses one at a time (e.g. 100 g ≈ 1 N).

Measure the new length each time; extension = new length – original length.

Read the ruler at eye level to avoid parallax; repeat and take a mean.

Plot force against extension; k = gradient of the straight part.

Safety: goggles, keep feet clear, clamp the stand to the bench.

Levels marking: Level 3 (5–6) a clear, logical method that would give valid results.

Total: _____ / 20

How confident am I?

	Not yet	Nearly	Got it
I can describe elastic and inelastic deformation	☐	☐	☐
I can use F = ke	☐	☐	☐
I can describe the force and extension practical	☐	☐	☐