

GCSE Combined Science: Trilogy

Worksheet: Forces and elasticity

TIME 35 min	TOTAL 31 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
-----------------------	--------------------------	------------------------------	-----------------------------------

Topics: Forces and elasticity

NAME	CLASS	DATE
------	-------	------

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

0 1 . 1 Which of these objects is most likely to show elastic deformation when a small force is applied?

Tick (✓) **one** box.

A steel spring

☐

Wet clay

☐

A lump of putty

☐

A biscuit

☐

[1 mark]

0 1 . 2 Complete the sentence.

Work done in stretching a spring is stored as energy, as long as the spring is not permanently stretched.

.....

.....

.....

[1 mark]

0 1 . 3

A student compresses a spring of spring constant 25 N/m by 0.040 m.
Calculate the force needed.
Use the equation:
force = spring constant × extension

.....

.....

.....

.....

Force = N

[2 marks]

0 2

A spring in a toy has a spring constant of 80 N/m.

0 2 . 1

Calculate the force needed to stretch the spring by 0.09 m. The spring does not go beyond its limit of proportionality.
Use the equation:
force = spring constant × extension

.....

.....

.....

.....

Force = N

[2 marks]

0 3

0 3 . 1

A spring hangs from a clamp. A weight is hung from the bottom of the spring and the spring stretches.

Why must more than one force act on the spring to stretch it?

Tick (✓) **one** box.

A single force would make the spring move instead of changing its shape.

☐

A single force is always too small to stretch a spring.

☐

Two forces are needed to double the extension.

☐

The weight of the spring must be balanced first.

☐

[1 mark]

0 3 . 2

Describe the difference between elastic deformation and inelastic deformation.

.....

.....

.....

.....

[2 marks]

0 3 . 3

A spring has a spring constant of 40 N/m.

Calculate the force needed to stretch the spring by 0.15 m.

Use the equation:

force = spring constant $\times$ extension

.....

.....

.....

.....

Force = N

[2 marks]

0 3 . 4

A diver stands on the end of a diving board and the board changes shape.
Name the type of change of shape that happens to the diving board.

.....

.....

.....

[1 mark]

0 4

A force of 18.9 N stretches a spring in a door closer by 14.0 cm. The spring does not go beyond its limit of proportionality.

0 4 . 1

Calculate the spring constant of the spring, in N/m.

.....

.....

.....

.....

.....

Spring constant = N/m

[3 marks]

0 5

An archer pulls back a bowstring, storing elastic potential energy in the bow.

0 5 . 1

Describe the energy transfer that occurs from the moment the archer releases the bowstring to the moment just after the arrow leaves the bow.

.....

.....

.....

.....

[2 marks]

0 5 . 2

Explain why the archer must apply a bigger force to pull the bowstring back further.

.....

.....

.....

.....

[2 marks]

0 6

At a fixed force of 4.0 N, a student measures the extension of a spring three times, obtaining 38 mm, 40 mm and 39 mm. A second student, using an identical spring and the same masses, obtains a mean extension of 39 mm.

0 6 . 1

Are the first student’s three results repeatable? Justify your answer.

.....

.....

[1 mark]

0 6 . 2

Calculate the mean extension and its uncertainty, using the range of the readings.

.....

.....

.....

.....

.....

Mean extension = mm

[3 marks]

0 6 . 3

Does the second student's result show that the first student's result is reproducible? Justify your answer.

.....

.....

[1 mark]

0 7

A student investigated how the length of a spring changed when different weights were hung from it. The length of the spring with no weight attached was 4.0 cm. Table 1 shows the results.

Table 1

Weight in N	Length of spring in cm
0	4.0
1.0	6.5
2.0	9.0
3.0	11.5
4.0	14.0
5.0	16.9
6.0	20.6

0 7 . 1

Write down the equation that links extension (e), force (F) and spring constant (k).

.....

.....

[1 mark]

0 7 . 2

Calculate the extension of the spring when the weight was 3.0 N.

.....

.....

.....

Extension = cm

[1 mark]

0 7 . 3

Calculate the spring constant of the spring in N/m.

.....

.....

.....

.....

.....

Spring constant = N/m

[3 marks]

0 7 . 4

The limit of proportionality of the spring was exceeded during the investigation. Between which two weights was the limit of proportionality exceeded? Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Forces and elasticity · 31 marks

Question 1 (4 marks)

01.1 [1 mark]

Correct: A steel spring

01.2 [1 mark]

Answer: Elastic potential.

- elastic potential (1)
-

01.3 [2 marks]

Answer: 1.0 N

- $F = 25 \times 0.040$ (1)
 - 1.0 (N) (1)
-
-

Question 2 (2 marks)

02.1 [2 marks]

Answer: 7.2 N

- $F = 80 \times 0.09$ (1)
 - 7.2 (N) (1)
-

Question 3 (6 marks)

03.1 [1 mark]

Correct: A single force would make the spring move instead of changing its shape.

03.2 [2 marks]

Answer: Elastic: returns to its original shape when the force is removed. Inelastic: does not return to its original shape.

- elastic deformation: the object returns to its original shape / length when the force is removed (1)
 - inelastic deformation: the object does not return to its original shape / length when the force is removed (1)
-

03.3 [2 marks]

Answer: 6.0 N

- $F = 40 \times 0.15$ (1)
 - 6.0 (N) (1)
-

03.4 [1 mark]

Answer: Bending.

- bending (1)
-

Question 4 (3 marks)

04.1 [3 marks]

Answer: 135 N/m

- extension = 14.0 cm = 0.14 (m) (1)
- $k = 18.9 \div 0.14$ (1)
- 135 (N/m) (1)

Notes: An answer of 1.35 scores 2 marks (extension not converted to metres).

Question 5 (4 marks)

05.1 [2 marks]

Answer: From the bow's elastic potential energy store mainly to the arrow's kinetic energy store; some is dissipated to the surroundings by heating and as sound.

- energy is transferred from the elastic potential energy store of the bow mainly to the kinetic energy store of the arrow (1)
- some energy is dissipated to the surroundings: to thermal energy stores (because of friction and vibrations) and as sound (1)

05.2 [2 marks]

Answer: A bigger extension of the bow needs a bigger force (like a spring, $F = k e$).

- pulling the string back further gives the bow a greater extension (deformation) (1)
- the force needed increases with extension (like a spring, $F = k e$, if the bow stays within its limit of proportionality) (1)

Question 6 (5 marks)

06.1 [1 mark]

Answer: Yes — the three readings are close together (within 2 mm), obtained using the same equipment and method.

- yes — the three readings are close together (within 2 mm) using the same equipment and method (they are repeatable) (1)

06.2 [3 marks]

Answer: 39 mm, uncertainty = ± 1 mm

- mean = $(38 + 40 + 39) \div 3 = 39$ (mm) (1)
- uncertainty = $\pm$ half the range = $\pm (40 - 38) \div 2$ (1)
- = ± 1 (mm) (1)

06.3 [1 mark]

Answer: Yes — the second student obtained 39 mm with different (but identical-type) equipment, which matches the first student's mean.

- yes — the second student's result (39 mm), obtained by a different person with different apparatus, matches the first student's mean (so the result is reproducible) (1)
-

Question 7 (7 marks)

07.1 [1 mark]

Answer: $F = k e$

- $F = k e$ / force = spring constant $\times$ extension (1)

07.2 [1 mark]

Answer: 7.5 cm

- 7.5 (cm) (1)

07.3 [3 marks]

Answer: 40 N/m

- extension = 7.5 cm = 0.075 m (1)
- $k = 3.0 \div 0.075$ (1)
- 40 (N/m) (1)

Notes: Allow any correct pair of values from 1.0 N to 4.0 N. An answer of 0.4 (extension left in cm) scores 2 marks.

07.4 [2 marks]

Answer: Between 4.0 N and 5.0 N: up to 4.0 N the extension increases by 2.5 cm per newton, but from 4.0 N to 5.0 N it increases by 2.9 cm.

- between 4.0 N and 5.0 N (1)
 - the extension increased by 2.9 cm (not 2.5 cm) for the extra 1.0 N / the extension at 5.0 N (12.9 cm) is more than the 12.5 cm expected if it were proportional (1)
-