Hookes Law Elasticity

GCSE Physics · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

A spring has a spring constant of 25 N/m. Calculate the force needed to stretch it by 0.20 m. (2 marks)

Step 1 · Write the equation

force = spring constant × extension, $F = k\,e$

Step 2 · Substitute and calculate

$F = 25 \times 0.20 = 5.0$ N

Answer: 5.0 N

Check: Extension must be in metres when k is in N/m.

2. Now try one with the steps

A spring is 12.0 cm long. With a 4.0 N weight hung on it, it is 20.0 cm long. Calculate the spring constant. (3 marks)

Step 1 · Extension

Step 2 · Rearrange

Step 3 · Calculate

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. Explain why more than one force is needed to stretch a spring. [1]

2. Describe the difference between elastic and inelastic deformation. [2]

3. State Hooke's law. [2]

4. A spring has k = 25 N/m and is stretched by 0.20 m. Calculate the force applied. [2]

5. A spring is 12.0 cm long. When stretched it is 15.5 cm long. State its extension. [1]

6. A spring with k = 40 N/m has a 6.0 N force applied. Calculate its extension. [2]

7. A 4.0 N force extends a spring by 8.0 cm. Calculate the spring constant in N/m. [3]

8. Define the limit of proportionality. [1]

9. A spring with k = 200 N/m is stretched by 0.050 m. Calculate the elastic potential energy stored in joules. [2]

10. A force–extension graph has force on the y-axis. State what the gradient of the straight part represents. [1]

11. Calculate the work done in stretching a spring (k = 80 N/m) by 0.25 m, within the limit of proportionality. Give your answer in joules. [2]

12. Explain what it means when a force–extension graph starts to curve. [2]

13. A 0.60 kg mass hangs from a spring with k = 120 N/m. Calculate the extension in cm. g = 9.8 N/kg. [3]

14. A bungee rope's force–extension graph is a straight line from (0 m, 0 N) to (20 m, 500 N). Calculate the work done stretching it 20 m, in joules. [2]

4. Before you hand it in

Using the stretched length extension
Extension = stretched length − original length.

k = 4.0 ÷ 8.0 = 0.5 N/m for 8.0 cm
Convert cm to m: 8.0 cm = 0.080 m, so k = 50 N/m.

Using F = k e beyond the limit of proportionality
Check the force is below the limit of proportionality before using F = k e or ½ k e².

Forgetting to square e in ½ k e²
½ × 200 × 0.05² = 0.25 J, not ½ × 200 × 0.05 = 5 J.