

Springs, wires and the stiffness of materials

Physics grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test lasts 45 minutes and is worth 20 marks. Use $g = 9.81 \text{ N/kg}$, show every step of your working, give answers with units and convert all lengths to metres before substituting.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.4.2

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Stress and strain (3 marks)

A steel wire of diameter 1.2 mm carries a load of 90 N ($E = 2.0 \times 10^{11} \text{ Pa}$).

- Calculate the cross-sectional area. (1 mark)
- Calculate the stress. (1 mark)
- Calculate the strain. (1 mark)

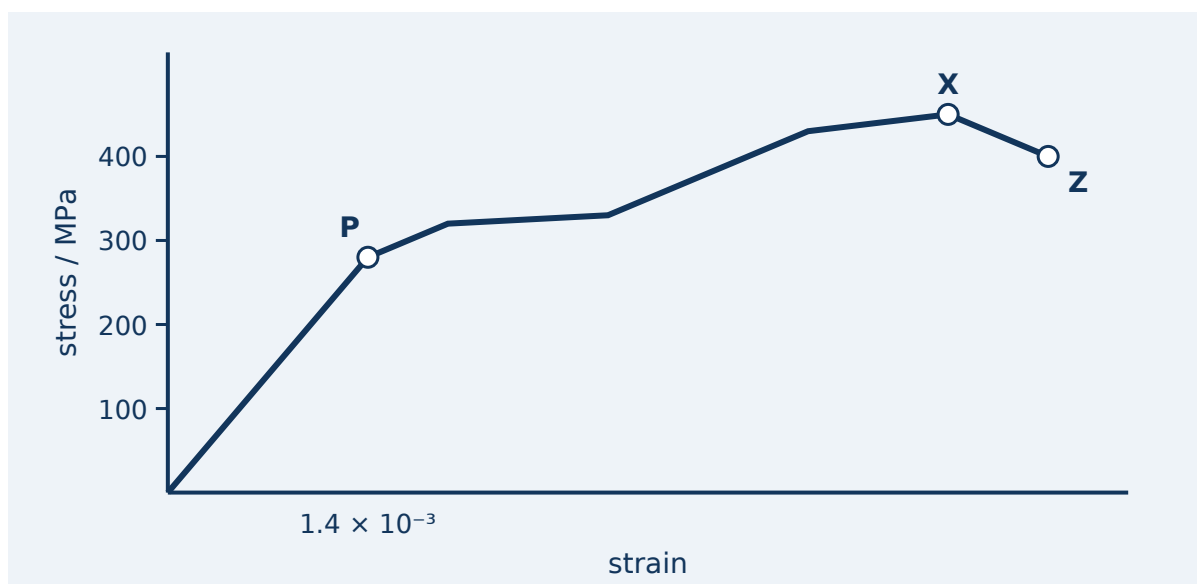
Question 2 Spring energy (3 marks)

A force of 25 N extends a spring by 0.080 m.

- Calculate the force constant. (1 mark)
- Calculate the energy stored. (2 marks)

Question 3 Reading a stress-strain graph (3 marks)

The graph is for a metal wire.



Stress against strain for a metal wire.

- Calculate the Young modulus from the straight part. (2 marks)
- Name the quantity represented by the stress at X. (1 mark)

Question 4 Aluminium wire (3 marks)

An aluminium wire ($E = 7.0 \times 10^{10} \text{ Pa}$) is 3.00 m long with diameter 1.0 mm. A 40 N load is attached.

- Calculate the stress. (1 mark)
- Calculate the strain. (1 mark)
- Calculate the extension in mm. (1 mark)

Question 5 Elastic and plastic (2 marks)

A wire is stretched beyond its elastic limit and then the load is removed. Explain what happens to its length and why.

Question 6 Brittle fracture (2 marks)

Explain the shape of the stress-strain graph of glass and why glass is described as brittle.

Question 7 Extra energy (2 marks)

A spring of force constant 400 N/m is stretched from an extension of 0.020 m to 0.050 m. Calculate the extra energy stored.

Question 8 Area under a graph (2 marks)

State what the area under a force-extension graph represents and explain why it is not

| always recoverable.