FREE REVISION PACK

Stress, Strain & the Young Modulus

AQA A-level Physics · 7407 / 7408 · Specification 3.4.2.2

Easy | Medium | Hard | Multiple choice · past-paper questions

8	8	≈ 10 min
QUESTIONS	TOTAL MARKS	SUGGESTED TIME*

Contents

Q	LEVEL	FOCUS	SOURCE	MARKS
1	Easy	Units of the Young modulus	AQA June 2017 · AS Paper 2 · Q26	1 mark
2	Easy	Order of magnitude of a stress	AQA June 2019 · A-level Paper 1 · Q19	1 mark
3	Easy	Young modulus from a stress–strain graph	AQA June 2023 · AS Paper 2 · Q27	1 mark
4	Medium	Does the Young modulus depend on the sample?	AQA June 2017 · A-level Paper 1 · Q24	1 mark
5	Medium	Comparing stress, strain and extension in two wires	AQA June 2022 · A-level Paper 1 · Q28	1 mark
6	Medium	Stress along a heavy hanging cable	AQA June 2023 · A-level Paper 1 · Q26	1 mark
7	Hard	Extension of a longer, thinner wire	AQA June 2019 · AS Paper 2 · Q28	1 mark
8	Hard	Stress ÷ strain for two joined wires	AQA June 2025 · AS Paper 2 · Q21	1 mark

Key ideas to have ready

- Tensile **stress** $\sigma = F / A$ (Pa). Tensile **strain** $\varepsilon = \Delta L / L$ (no unit).
- **Young modulus** E = stress ÷ strain = $FL / (A\Delta L)$. Unit: Pa = N m^{-2} = kg m^{-1} s^{-2}. It is a property of the material, not of the sample.
- Rearranged: $\Delta L = FL / (AE)$. For a round wire $A = \pi d^2/4$, so for the same force and material $\Delta L \propto L / d^2$.
- The gradient of the straight part of a stress–strain graph is E. The breaking stress is the largest stress before the material breaks.

How to use this pack

1. The questions are grouped into levels (Easy, Medium and Hard). Work through them in order, and check your answers at the end of each level before moving on.
2. Every question is multiple choice with one correct answer. Write down your working anyway; that is how you find mistakes.
3. The separate mark scheme uses the same numbers and explains every answer.

Levels are based on how students did in AQA's examiner reports where that information exists, plus our own difficulty rating. *About 1.5 minutes per question.

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Easy

Definitions and one-step ideas. Most students get these right.

Questions 1–3

Only **one** answer per question is allowed. For each question, completely fill in the circle alongside the appropriate answer.

AQA June 2017 · AS Paper 2 · Q26

1 What **cannot** be used as a unit for the Young modulus?

[1 mark]

A $\mathrm{N\,m^{-2}}$ ⬭

B Pa ⬭

C $\mathrm{kg\,m^{-2}\,s^{-2}}$ ⬭

D $\mathrm{kg\,m^{-1}\,s^{-2}}$ ⬭

AQA June 2019 · A-level Paper 1 · Q19

2 A load of $50\ \mathrm{N}$ is suspended from a wire that has an area of cross-section of $1\ \mathrm{mm^2}$.

The stress in the wire, in Pa, is between

[1 mark]

A 10^0 and 10^3 ⬭

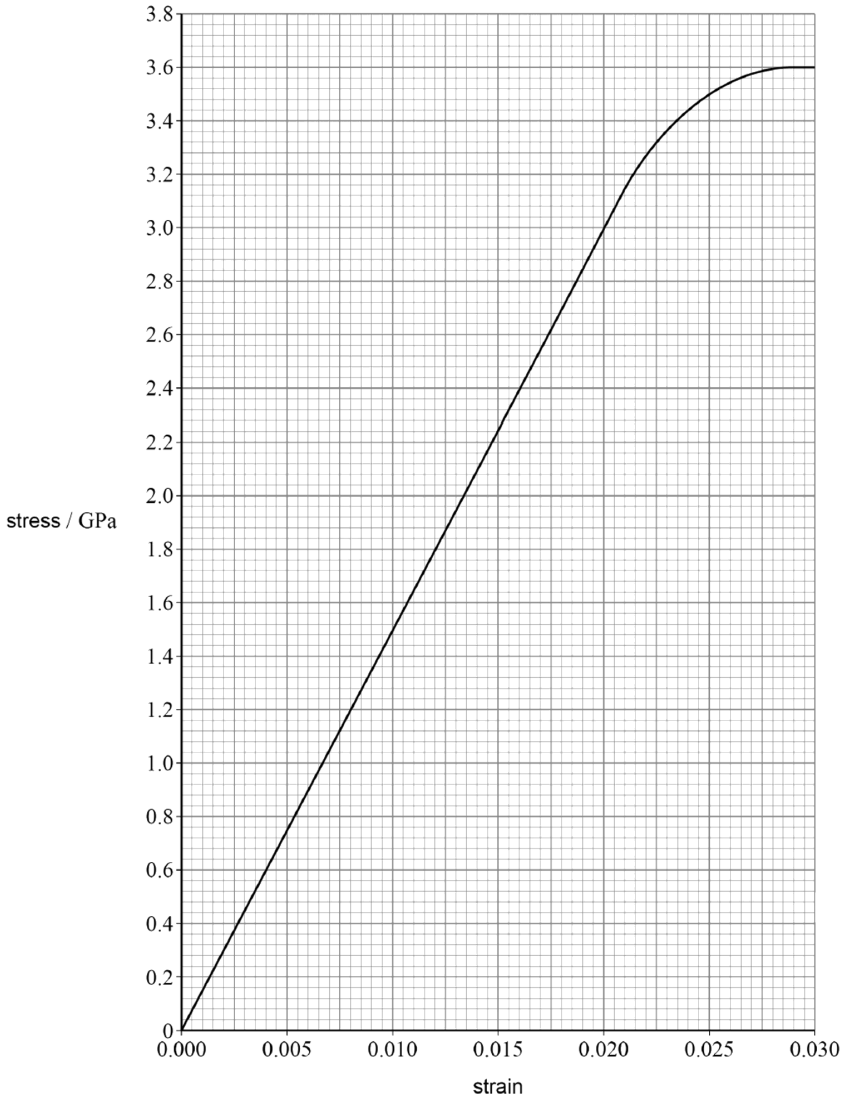
B 10^3 and 10^6 ⬭

C 10^6 and 10^9 ⬭

D 10^9 and 10^{12} ⬭

AQA June 2023 · AS Paper 2 · Q27

3 The graph shows the variation of stress with strain for a material.



What is the Young modulus of the material?

A 1.2×10^5 Pa ⬭

B 1.5×10^5 Pa ⬭

C 1.2×10^{11} Pa ⬭

D 1.5×10^{11} Pa ⬭

Medium

Two or three steps. Roughly a third to a half of students get these right.

Questions 4–6

AQA June 2017 · A-level Paper 1 · Q24

4 A sample of wire has a Young modulus E. A second sample of wire made from an identical material has three times the length and half the diameter of the first sample.

What is the Young modulus of the second sample of wire in terms of E?

[1 mark]

A $0.25E$ ⬭

B E ⬭

C $6E$ ⬭

D $12E$ ⬭

AQA June 2022 · A-level Paper 1 · Q28

5 Two wires P and Q are made of the same material and have the same cross-sectional area.
P has an original length L and is subject to a tensile force F. P extends a distance x.
Q has an original length $2L$ and is subject to a tensile force $2F$.

Which statement is correct?

[1 mark]

A The stress in P and the stress in Q are the same. ⬭

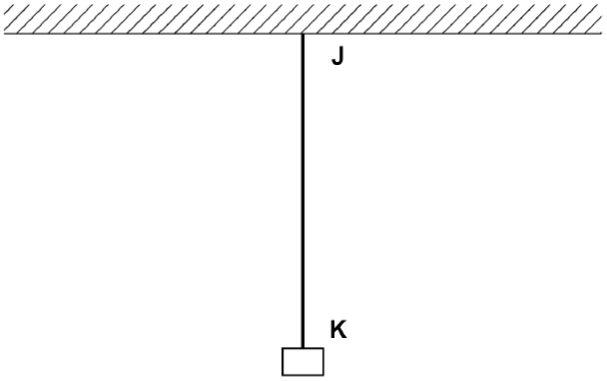
B The extension of Q is $2x$. ⬭

C The strain of Q is double the strain of P. ⬭

D The value of $\frac{\text{stress}}{\text{strain}}$ for P is half that of Q. ⬭

AQA June 2023 · A-level Paper 1 · Q26

6 A heavy cable is attached to a fixed support and carries a load at its lower end.

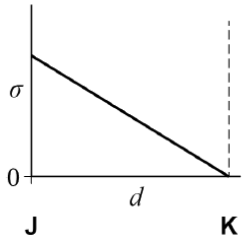


The weight of the cable is **not** negligible.
The cable has constant cross-sectional area and density.

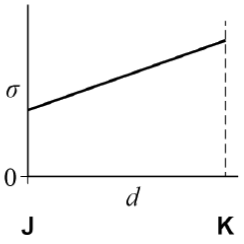
Which graph shows the variation of tensile stress σ in the cable with distance d from **J** to **K**?

[1 mark]

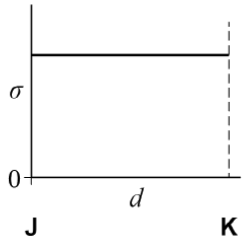
A



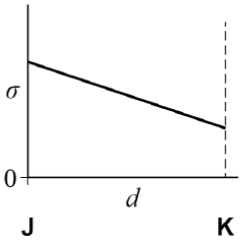
B



C



D



Hard Several steps, often with a trap built in. Fewer than 3 in 10 students get these right. **Questions 7–8**

AQA June 2019 · AS Paper 2 · Q28

7 A tensile force produces an extension ΔL in a steel wire of initial length L and diameter d.
The same steel is used to make a second wire of initial length $2L$ and diameter $\frac{d}{2}$.
What is the extension when the same force is applied to the second wire?

[1 mark]

A $\frac{\Delta L}{2}$ ⬭

B $2\Delta L$ ⬭

C $4\Delta L$ ⬭

D $8\Delta L$ ⬭

AQA June 2025 · AS Paper 2 · Q21

8 **P** and **Q** are wires made from the same material.
The length of **Q** is double the length of **P**.
The diameter of **Q** is double the diameter of **P**.
P and **Q** are joined.

One end of **P** is held firmly and a force F is applied to **Q** as shown.



$X_P = \frac{\text{stress in P}}{\text{strain of P}}$

$X_Q = \frac{\text{stress in Q}}{\text{strain of Q}}$

X_Q is equal to:

[1 mark]

A $\frac{X_P}{4}$ ⬭

B X_P ⬭

C $2X_P$ ⬭

D $4X_P$ ⬭

End of questions. Check your answers with the matching mark scheme. More free packs and 1-to-1 tuition:
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