GET BETTER AT PHYSICS · MARK SCHEME

Elastic Strain Energy: tiered multiple choice

AQA A-level Physics · 7407 / 7408 · Specification 3.4.2.1 · 6 questions · 6 marks

1 mark per correct letter | Worked reasoning for every question | **How students did** = from AQA examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5	Q6
A	B	C	D	D	C

Medium

Questions 1–3

1 **A**

Strain energy in terms of the Young modulus · AQA June 2022 · AS Paper 2 · Q29

Energy = ½FΔL. From the Young modulus, F = EAe / L. So energy = ½ × (EAe / L) × e = AEe^2 / (2L).

> **Watch out:** A stiffer material (bigger E) stores more energy for the same extension, so E must be on the top: that rules out B and C. Energy grows with e^2, which rules out D.

2 **B**

Which wire extends least before breaking? · AQA June 2018 · AS Paper 2 · Q23

$E = ½kx^2$, so $x = \sqrt{(2E / k)}$. A: $\sqrt{(2/4)}$ = 0.71 m. B: $\sqrt{(2/9)}$ = 0.47 m. C: $\sqrt{(6/16)}$ = 0.61 m. D: $\sqrt{(6/25)}$ = 0.49 m. B has the smallest extension.

> **Watch out:** B and D are close (0.47 m and 0.49 m). Work every option out rather than judging by eye.

How students did: 42.7% of students got this right in June 2018.

3 **C**

Average power from a released spring · AQA June 2024 · A-level Paper 1 · Q26

The energy stored in the compressed spring is $½k(\Delta L)^2$. It is released in time t, so the average power = $k(\Delta L)^2$ / (2t).

> **Watch out:** A and B use the force kΔL in place of the energy. Power is energy ÷ time, so start from the stored energy.

Hard

Questions 4–6

4 **D**

Graphs of strain energy against extension and tension · AQA June 2024 · AS Paper 2 · Q10

$E_S = ½k\Delta L^2$, so E_S against ΔL is a curve through the origin. The tension T = kΔL, so $E_S = T^2 / (2k)$: E_S against T is also a curve through the origin. Both graphs curve: D.

> **Watch out:** $E_S = ½T\Delta L$ can look linear in each variable, but T and ΔL increase together, so neither graph is a straight line.

How students did: This was a hard question in June 2024: the wrong answers A, B and C were about equally popular.

5 **D**

Adding mass to a hanging spring · AQA June 2022 · A-level Paper 1 · Q27

At rest, the spring force equals the weight, and the energy stored = F^2 / (2k), so $E \propto F^2$. Adding 2M makes the total mass 3M, so the force is 3 times larger and the energy is 3^2 = 9 times larger: 9E.

> **Watch out:** 3E (B) assumes energy is proportional to force. The extension also triples, so the energy goes up by 3 × 3.

How students did: In June 2022 all four options were roughly equally popular.

6 **C**

Increase in strain energy when the load doubles · AQA June 2024 · A-level Paper 1 · Q25

Energy stored $\propto F^2$, so doubling the load makes the total energy 4E. The **increase** is 4E − E = 3E.

> **Watch out:** 4E (D) is the new total, not the increase. Check what the question is asking for.

How students did: Fewer than 12% of students got this right in June 2024.

End of mark scheme. Answers from AQA's published keys; explanations written for this pack. AQA material is © AQA. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

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