GET BETTER AT PHYSICS · MARK SCHEME

Energy Levels & Line Spectra: tiered multiple choice

AQA A-level Physics · 7407 / 7408 · Specification 3.2.2.2–3.2.2.3 · 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
D	B	C	A	D	C

Easy

Questions 1–3

1 **D**

Which transition gives ultraviolet? · AQA June 2016 · AS Paper 2 · Q10

$E_3 \rightarrow E_1$ releases $-0.85 - (-3.39) = 2.54$ eV (visible). Ultraviolet needs more energy per photon. $E_1 \rightarrow E_0$ releases $-3.39 - (-13.6) = 10.2$ eV, well into the UV. The other transitions release less than 2.54 eV.

Watch out: Higher photon energy means higher frequency and shorter wavelength.

How students did: About two-thirds of students got this right in June 2016.

2 **B**

What the coating of a fluorescent tube does · AQA June 2022 · A-level Paper 1 · Q15

Excited mercury atoms in the gas emit ultraviolet photons. The coating absorbs these and its atoms de-excite in smaller steps, emitting visible light.

Watch out: The coating doesn't emit photoelectrons (C): no electrons leave it.

How students did: This was one of the easiest questions on the June 2022 paper.

3 **C**

Evidence for discrete energy levels · AQA June 2022 · AS Paper 2 · Q13

A line spectrum contains only certain wavelengths. Each line is a photon with one exact energy, which shows that the electrons can only move between fixed energy levels.

Watch out: Electron diffraction and the photoelectric effect are evidence for wave–particle duality, not energy levels.

Medium

Questions 4–6

4 **A**

Kinetic energy left after a collision · AQA 2021 · AS Paper 2 · Q13

Exciting the atom from n = 1 to n = 2 needs $-2.9 \times 10^{-19} - (-8.6 \times 10^{-19}) = 5.7 \times 10^{-19}$ J. The free electron keeps the rest: $6.0 \times 10^{-19} - 5.7 \times 10^{-19} = 0.3 \times 10^{-19}$ J.

Watch out: A colliding electron gives up only the energy needed for the transition. A photon would have to be absorbed completely.

5 **D**

Energy gap between two excited states · AQA June 2022 · AS Paper 2 · Q12

$E = hc / \lambda$. X → ground: $1.99 \times 10^{-25} \div 147 \times 10^{-9} = 1.35 \times 10^{-18}$ J. Y → ground: $1.99 \times 10^{-25} \div 160 \times 10^{-9} = 1.24 \times 10^{-18}$ J. Difference = 1.1×10^{-19} J.

Watch out: Work out each energy first, then subtract. Subtracting the wavelengths does not give the energy gap.

6 **C**

Number of lines after photon excitation · AQA June 2025 · A-level Paper 1 · Q33

12.74 eV raises an electron from −13.59 eV to −0.85 eV, which is n = 4. On the way back down it can make any transition between levels 4, 3, 2 and 1: 4→3, 4→2, 4→1, 3→2, 3→1, 2→1. That is 6 different photon frequencies.

> **Watch out:** Count every possible pair of levels, not just the jumps straight down to the ground state.

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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