FREE REVISION PACK

Energy Levels & Line Spectra

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

Easy | Medium | Multiple choice · past-paper questions

6	6	≈ 10 min
QUESTIONS	TOTAL MARKS	SUGGESTED TIME*

Contents

Q	LEVEL	FOCUS	SOURCE	MARKS
1	Easy	Which transition gives ultraviolet?	AQA June 2016 · AS Paper 2 · Q10	1 mark
2	Easy	What the coating of a fluorescent tube does	AQA June 2022 · A-level Paper 1 · Q15	1 mark
3	Easy	Evidence for discrete energy levels	AQA June 2022 · AS Paper 2 · Q13	1 mark
4	Medium	Kinetic energy left after a collision	AQA 2021 · AS Paper 2 · Q13	1 mark
5	Medium	Energy gap between two excited states	AQA June 2022 · AS Paper 2 · Q12	1 mark
6	Medium	Number of lines after photon excitation	AQA June 2025 · A-level Paper 1 · Q33	1 mark

Key ideas to have ready

- Electrons in atoms can only have certain energies (energy levels). Moving between levels needs, or releases, an exact amount of energy.
- A photon emitted in a transition has energy $hf = hc / \lambda = E_{upper} - E_{lower}$. Bigger energy gaps give higher frequencies (towards ultraviolet).
- Excitation can be by a photon of exactly the right energy, or by a colliding electron, which can give part of its kinetic energy and carry on with the rest.
- Line spectra are evidence for discrete energy levels. In a fluorescent tube, mercury atoms emit UV; the coating absorbs it and re-emits visible light.

How to use this pack

1. The questions are grouped into levels (Easy and Medium). 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

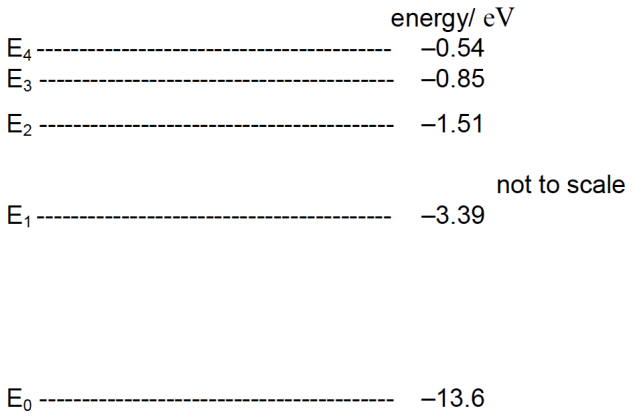
Definitions and one-step ideas. Most students get these right.

Questions 1–3

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

AQA June 2016 · AS Paper 2 · Q10

1 The diagram gives some of the energy levels of a hydrogen atom.



The transition of an excited hydrogen atom from E_3 to E_1 causes a photon of visible light to be emitted.

Which transition causes a photon of ultraviolet light to be emitted?

[1 mark]

A E_4 to E_3 ⬭

B E_3 to E_2 ⬭

C E_2 to E_1 ⬭

D E_1 to E_0 ⬭

AQA June 2022 · A-level Paper 1 · Q15

2 A fluorescent tube contains a gas.

The coating of the tube

[1 mark]

A becomes ionised by the gas and emits photons of ultraviolet light. ⬭

B absorbs photons of ultraviolet light from the gas and emits visible light. ⬭

C absorbs photons of ultraviolet light from the gas and emits photoelectrons. ⬭

D absorbs several photons of visible light from the gas and then emits one photon of ultraviolet light. ⬭

AQA June 2022 · AS Paper 2 · Q13

3 Which provides evidence for discrete atomic energy levels?

[1 mark]

A β^+ decay ⬭

B electron diffraction ⬭

C line spectra ⬭

D the photoelectric effect ⬭

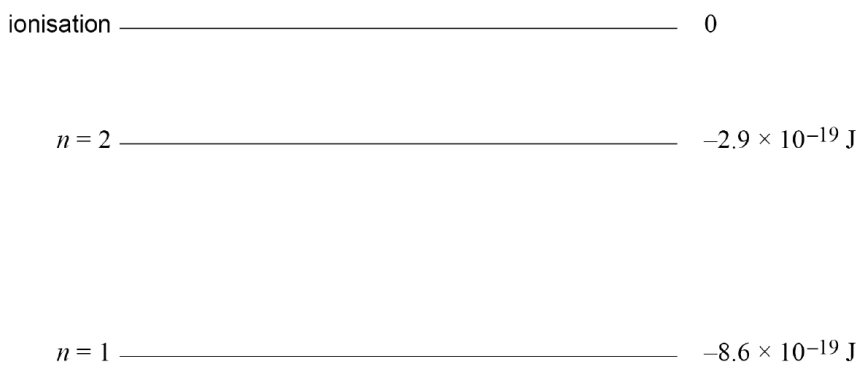
Medium

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

Questions 4–6

AQA 2021 · AS Paper 2 · Q13

4 Some energy levels of a lithium atom are shown below.



A free electron with kinetic energy 6.0×10^{-19} J collides with a stationary lithium atom in its $n = 1$ energy level. The lithium atom is excited to the $n = 2$ energy level.

What is the kinetic energy of the free electron after the collision?

[1 mark]

A 0.3×10^{-19} J ⬭

B 2.6×10^{-19} J ⬭

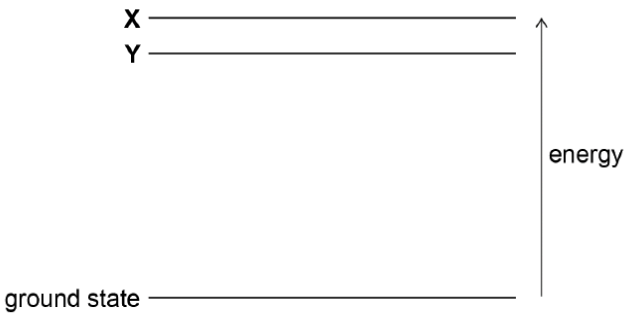
C 3.1×10^{-19} J ⬭

D 5.7×10^{-19} J ⬭

AQA June 2022 · AS Paper 2 · Q12

5 The diagram shows the ground state and two higher-energy states **X** and **Y** of an atom.

A transition from **X** to the ground state produces a photon of wavelength $147\ \text{nm}$.
A transition from **Y** to the ground state produces a photon of wavelength $160\ \text{nm}$.



What is the energy difference between **X** and **Y**?

[1 mark]

A $1.5 \times 10^{-17}\ \text{J}$ ⬭

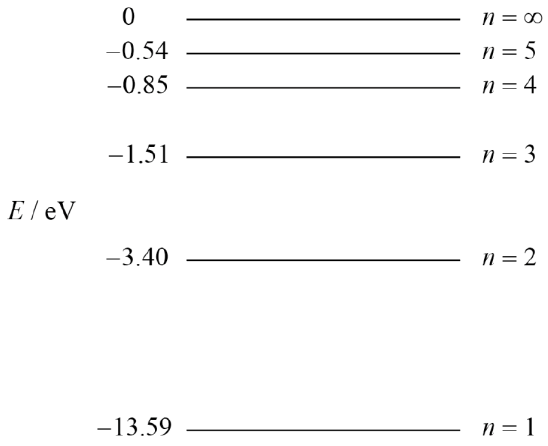
B $1.4 \times 10^{-18}\ \text{J}$ ⬭

C $1.2 \times 10^{-18}\ \text{J}$ ⬭

D $1.1 \times 10^{-19}\ \text{J}$ ⬭

AQA June 2025 · A-level Paper 1 · Q33

6 The diagram shows some of the energy levels for a hydrogen atom.



Photons of energy 12.74 eV excite hydrogen atoms that are all initially in the ground state ($n = 1$).

How many different photon frequencies are emitted as the atoms return to their ground state?

[1 mark]

A 3 ⬭

B 5 ⬭

C 6 ⬭

D 9 ⬭

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