GET BETTER AT PHYSICS · MARK SCHEME

Photoelectric Effect: tiered multiple choice

AQA A-level Physics · 7407 / 7408 · Specification 3.2.2.1 · 7 questions · 7 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	Q7
A	D	C	C	B	D	A

Easy

Questions 1–3

1 **A**

Maximum kinetic energy from a wavelength · AQA June 2018 · A-level Paper 1 · Q14

Photon energy = hc / λ = $(6.63 \times 10^{-34} \times 3.00 \times 10^{8}) \div (290 \times 10^{-9}) = 6.86 \times 10^{-19}$ J = 4.29 eV. $E_{k(max)}$ = 4.29 − 4.1 = 0.19 eV.

Watch out: Convert the photon energy to eV (÷ 1.60×10^{-19}) before subtracting the work function.

How students did: 76.5% of students got this right in June 2018.

2 **D**

Kinetic energy of the emitted electrons · AQA June 2019 · AS Paper 2 · Q11

Each electron absorbs the energy of one photon, 1.0×10^{-18} J. Some of that energy is needed to escape from the metal (at least the work function), so every emitted electron has less than 1.0×10^{-18} J of kinetic energy.

Watch out: Electrons absorb one photon each, so their energy can't be a multiple of the photon energy (B).

How students did: About 70% of students got this right in June 2019.

3 **C**

Gradient of E_k against 1/λ · AQA June 2018 · AS Paper 2 · Q9

$E_k = hf - \varphi = hc \times (1/\lambda) - \varphi$. Plotting E_k against 1/λ gives a straight line of gradient hc.

Watch out: Against frequency the gradient would be h; against 1/λ it is hc.

How students did: 67.8% of students got this right in June 2018.

Medium

Questions 4–6

4 **C**

Doubling the power of the light · AQA June 2017 · AS Paper 2 · Q20

The frequency is unchanged, so each photon has the same energy and $E_{k(max)}$ stays the same. Doubling the power doubles the number of photons per second, so the number of photoelectrons per second doubles.

Watch out: Power (intensity) controls how many electrons are emitted, not how much energy each one has.

How students did: In June 2017, 30% of students chose B.

5 **B**

Raising the frequency at a fixed photon rate · AQA June 2023 · AS Paper 2 · Q13

The rate at which photons arrive is unchanged, so the rate of electron emission, and the current I, stay the same. Each photon now has more energy, so $E_{k(max)}$ rises and a larger stopping potential is needed: row B.

Watch out: The question fixes the number of photons per second, not the power.

6 **D**

The Planck constant from an $E_{k(max)}$–f graph · AQA June 2025 · A-level Paper 1 · Q30

$E_{k(max)} = hf - \varphi$. The E_k-intercept is $-\varphi$, so $q = \varphi$. The f-intercept is the threshold frequency $r = \varphi / h$. So $h = \varphi / r = q / r$.

> **Watch out:** The gradient p is also equal to h, but p on its own is not one of the options.

Hard

Question 7

7 **A**

Raising the frequency at a fixed rate of energy · AQA June 2024 · A-level Paper 1 · Q10

Higher frequency means each photon carries more energy, so $E_{k(max)}$ increases. The energy arriving per second is unchanged, so fewer photons arrive each second. Fewer photons means fewer electrons per second, so the current I decreases: row A.

> **Watch out:** Here the energy per second is fixed, not the number of photons per second. Compare this with a fixed photon rate, where I would not change.

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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